

A BRIEF  
HISTORY  
OF  
THE BOEING  
COMPANY

7-  
**BOEING**

BOEING

DOUGLAS

DOUGLAS

Boeing

BOEING

MCDONNELL  
DOUGLAS

MCDONNELL COMPANY

MCDONNELL

Douglas Corporation

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### THE SHARED HERITAGE

*"To affirm that the airplane is going to revolutionize the future is to be guilty of the wildest exaggeration."*

—Scientific American magazine, 1910

During the last 100 years, humans went from walking on Earth to walking on the moon. They went from riding horses to flying jet airplanes. With each decade, aviation technology crossed another frontier, and, with each crossing, the world changed.

Airplane travel was first a luxury enjoyed only by the wealthy. By the end of the 20th century, from airports around the globe, passenger jets were taking off by the thousands, 24 hours a day.

By the dawning of the new millennium, Boeing, North American Aviation, McDonnell, and Douglas airplane companies had joined forces. The four aviation giants had helped chart the course of aviation history in this country. Their logbooks had recorded almost a century of victory and defeat, cooperation and competition, high adventure, and hard struggle.

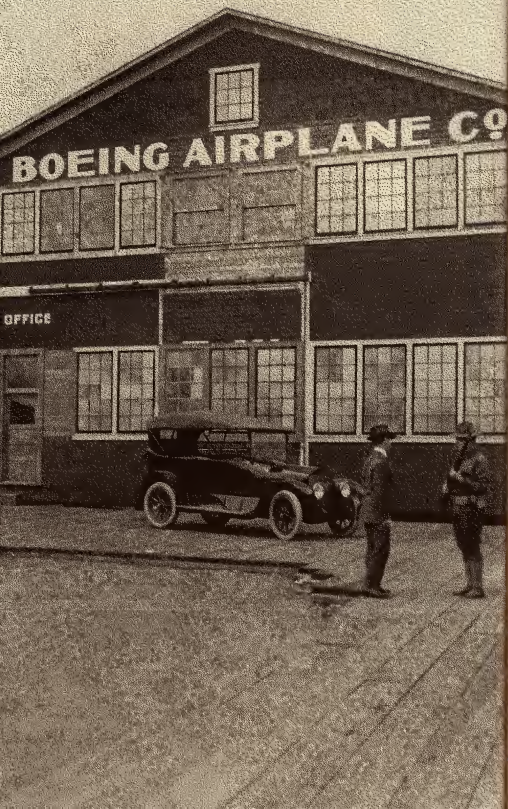
Their story began with four men, born before the 20th century, who shared the vision that gave tangible wings to the eternal dream of flight.

Three of the men created legendary aerospace companies bearing their names. The fourth led his company from building small pontoons to putting humans on the moon.

William Edward Boeing, born in 1881 in Detroit, Mich., began building floatplanes near Seattle, Wash. James Smith McDonnell, born 1899 in Denver, Colo., began building jet fighters in St. Louis, Mo. Donald Wills Douglas, born in 1892 in New York, began building bombers and passenger transports in Santa Monica, Calif. James Howard "Dutch" Kindelberger, born in 1895 in Wheeling, W. Va., began building trainers in Los Angeles, Calif.

All four established their aviation careers with Glenn Martin, one of the founders of the Lockheed Martin Corp. Boeing enrolled in Martin's flying school in 1915 and brought a Martin biplane back to Seattle to fly. Douglas, McDonnell, and Kindelberger each spent time as Martin's chief engineer, learning the ropes before starting out on their own.

The four began their journey into the annals of aerospace at different times, and under different circumstances, but their paths merged and their contributions are the common heritage of The Boeing Company today.



# *The beginnings*

*1915-1934*

## THE BOEING AIRPLANE COMPANY

*"We are embarked as pioneers upon a new science and industry in which our problems are so new and unusual that it behooves no one to dismiss any novel idea with the statement, 'It can't be done.'"*

—William Boeing

In 1903, the Wright brothers made their first flight at Kitty Hawk, N.C., and 22-year-old William Boeing left Yale engineering college for the West Coast. After making his fortune trading forest lands around Grays Harbor, Wash., Boeing moved to Seattle in 1908.

Two years later, Boeing went to Los Angeles for the first American air meet and tried unsuccessfully to get a ride in one of the airplanes. He came back to Seattle disappointed but determined to learn more about this new science of aviation.

Boeing shared this fascination with George Conrad Westervelt, a Navy engineer, stationed in Seattle, who had studied aeronautics at the



Massachusetts Institute of Technology (MIT). They took a trial flight on a biplane flown by a visiting barnstormer and started a club for aviation enthusiasts. Both were convinced they could make a biplane better than any on the market.

Boeing learned to fly a Martin biplane and bought a couple for himself. Then, in 1915, the two friends began building their own twin-float seaplane in Boeing's boathouse. They named it the B & W, after their initials.

Unfortunately, Westervelt was posted to the East Coast before the plane was finished. Boeing continued alone and completed two B & Ws during the following year. On July 15, 1916, Boeing incorporated his airplane manufacturing business as the Pacific Aero Products Company. A year later, he changed the name to the Boeing Airplane Company.

By 1917, and the beginning of World War I, Boeing's 28-person payroll included pilots, carpenters, boat builders, and seamstresses as well as engineers. When the B & W did not sell, Boeing used his own financial resources to guarantee a loan to cover all the wages – a total of about \$700 a week.

As American airplanes went into battle, Westervelt wrote to Boeing encouraging him to build Navy trainers, and Boeing's new engineer, Tsu Wong, designed the Model C seaplane for that purpose. The biplanes could not fly all the way across the country to Pensacola, Fla., where Navy officials were testing proposed airplanes, so Boeing disassembled two Model C planes, packed them in crates, and shipped them by rail.

Once in Florida, the Boeing factory superintendent and the test pilot put the airplanes back together and flew them over six-foot swells. The Model C planes impressed the Navy onlookers, and Boeing landed his first contract, for 50 Model C seaplane trainers.

By May 1918, 337 people worked for Boeing.

However, after the war ended Nov. 11, 1918, military orders were canceled and civilians bought the war-surplus biplanes that glutted the market. At the end of 1919, only 67 employees were left. Struggling to survive, the tiny airplane company began to build dressers, counters, and furniture for a corset company and a confectioner's shop as well as flat-bottomed boats called Sea Sleds.

Boeing kept his faith in the future of commercial aviation. He built prototypes of several biplanes for civilian use, but none went into production. He demonstrated how airplanes could be used for international mail delivery in 1919 when he and pilot Eddie Hubbard carried 60 letters from Vancouver, B.C., to Seattle in Boeing's C-700.

The Boeing Airplane Company survived with contracts from U.S. Army Air Service to modernize 298 British-designed de Havilland DH-4 biplanes and build 25 Curtiss Aeroplane and Motor Company-designed HS-2L seaplanes as well as 200 Thomas Morse MB-3A pursuit fighter biplanes. It was clear, however, that to prosper, the company needed to build, mass produce, and sell aircraft of its own design.

1915

1922

1929

1936

■ B & W  
▲ Pacific Aero Products changes name to Boeing Airplane Company  
■ C-700  
▲ Pacific Aero Products established

■ B-1 biplane transport  
■ The Cloudster  
▲ Davis Douglas Company founded

■ DT bomber  
■ PW-9 fighter  
■ DMC NB-1 Navy biplane

■ XD-2 observation plane  
■ DAM-1 mailplane

▲ Charles Lindbergh makes the first solo transatlantic nonstop flight  
■ Model 80  
■ Model 40A

■ The Doodletug  
▲ UATC (Boeing conglomerate) established  
■ The Depression  
■ Y1B-99  
■ P-25  
■ Model 247

■ Stearman Kaydet

▲ North American founded  
■ UATC split up; Boeing Aircraft Co. reestablished  
■ DC-1



## THE DOUGLAS COMPANY

"You've got a real cloud duster, Doug."

—Test pilot Eric Springer, so naming The Cloudster

Donald Wills Douglas was 11 years old when the Wright brothers made their first powered flight. He was 19 when he left the U.S. Naval Academy at Annapolis, Md., to take aeronautical engineering at the Massachusetts Institute of Technology. Douglas completed the four-year program in two and, in 1915, went to work for Glenn Martin at the company's Los Angeles headquarters.

During World War I, Douglas served a term as chief civilian aeronautical engineer for the Army Signal Corps Aviation Section and then returned to Martin, now relocated in Cleveland, Ohio. During this time, Douglas designed the Martin MB-1 bomber, which first flew Aug. 17, 1918.

Douglas started his career as an airplane manufacturer of the Glenn L. Martin Aircraft Company, provided it built an airplane that would make the first nonstop, coast-to-coast flight.

The Davis Douglas Company set up shop first in the back room of a Pico Boulevard barber shop and then in a 3,600-square-foot loft above a Los Angeles planing mill. Helped by a staff of five former employees of the Glenn L. Martin Aircraft Company, Douglas designed and built The Cloudster, which first flew Feb. 24, 1921.

In June 1921, The Cloudster set out for its nonstop flight from March Field, Calif., to Curtiss Field, N.Y. Engine trouble forced it to make an emergency landing in Texas, so The Cloudster was flown back to March Field for installation of an improved engine. By then, Douglas had landed a contract to build torpedo bombers for the Navy, starting with the DT-1 (Douglas torpedo 1), followed by the DT-2 production version.

The Cloudster was then rebuilt as an airliner and sold to Claude Ryan. With the ability to carry 12 passengers, it became the flagship of Ryan's San Diego-

Los Angeles airline, one of the first scheduled passenger lines in the country.

The Cloudster ultimately was beaten on its trip across the country by two Army pilots in a Fokker monoplane. Davis sold his portion of the company to Douglas and left the business, so, in July 1921, Douglas incorporated The Douglas Company on his own.

In the summer of 1922, Douglas leased an abandoned movie studio on Wilshire Boulevard near Santa Monica. There he began to build the Douglas World Cruiser, based on the DT-2. Two of these ultimately circled the world, flying 27,000 miles in a little more than 371 hours of actual flight time, earning the company its motto, "First Around the World."

By the mid-1920s, Douglas was a major manufacturer of military airplanes; versions of the Douglas biplane were flown by commercial users and by the Army and the Navy to carry mail, for aerial observation, as attack airplanes, as seaplanes, and as transports. He hired several key people, including engineer Edward H. Heinemann, who would go on to design many innovative aircraft; James Howard "Dutch" Kindelberger, who later would run North American Aviation; and John K. "Jack" Northrop, who would build one of the earliest "flying wings."

## JAMES SMITH MCDONNELL

James Smith McDonnell had just graduated from Little Rock High School in Arkansas as World War I began. He joined the Army and served as a private. After the war, McDonnell went to Princeton to get his bachelor of science in physics, before studying aeronautical engineering at MIT.



1915

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C-700  
▲ Pacific Aero Products established

B-1

The Cloudster

biplane transport

1922

The Cloudster

biplane transport

▲ Davis Douglas Company founded

heavy biplane

DT

bomber

PW-9

fighter

XD-2

observation plane

DWC

DWC

NB-1

heavy biplane

D4B-1

mailplane

1929

▲ Charles Lindbergh makes the first solo transatlantic nonstop flight  
Model 40A  
Model 8  
The Doodiebug  
▲ UATC (Boeing conglomerate) established  
▲ The Depression

Y18-3499

P-28

Model 247

Gamma

DC-1

Stearman

Kaydett

1936

▲ North American founded  
▲ UATC split up; Boeing Aircraft Co. reestablished

## NORTH AMERICAN AVIATION, INC.

*"We started with an obvious disadvantage. It couldn't have been much worse."*

—Dutch Kindelberger

During the prosperous, roaring 1920s, companies dedicated to airplane manufacturing, engines, propellers, passenger flight, and support industries sprouted across the country. By 1926, Douglas was building 120 airplanes a year. In 1928, with 800 employees, Boeing was one of the biggest airplane manufacturers in the industry.

Among holding companies for new ventures in aviation was North American Aviation, Inc. (NAA), incorporated in Delaware on Dec. 6, 1928.



NAA had interests in a number of leading airlines and aircraft manufacturing companies, including Douglas and the General Aviation Manufacturing Corp., located at the Curtis-Caproni plant at Dundalk, Md.

In 1934, New Deal legislation enacted during the Depression prevented

airplane manufacturers from holding air mail contracts and airline operators from building airplanes. Therefore, North American Aviation, Inc., relinquished its interest in Douglas as well as its interest in several airlines. It stopped operating as a holding company and took over the aircraft manufacturing operation at Dundalk.

After the reorganizational dust settled, this enterprise was called North American Aviation, Inc., and was run by Dutch Kindelberger, 39, formerly chief of engineering operations with the Douglas Aircraft Company. He was helped by Lee Atwood and J.S. "Stan" Smithson, two key designers and

engineers, also from Douglas. Twenty-six years later, Atwood would take over Kindelberger's position as president of North American Aviation, Inc.

In 1934, however, Kindelberger was essentially starting from scratch. NAA had never sold a single airplane; its only government contract was for 161 sets of pontoons for Navy observation planes.

Kindelberger, like Douglas, thought the California climate was better for testing airplanes. In 1935, he moved North American Aviation's machinery and 75 employees from Maryland to a 159,000-square-foot facility on 20 acres near the edge of the Los Angeles Municipal Airport. Rent was \$600 a year.

In March 1935, the Army gave NAA its first contract to design and build a basic trainer. The result was a two-place, low-wing monoplane trainer, the NA-16, that flew into competition at Wright Field in Dayton, Ohio, on April 22, 1935. It would lead to production of the BT-9 (basic trainer 9) airplanes and then to the well-known Texan and Harvard trainers built during World War II.

Kindelberger knew that NAA would have the best chance of success if it concentrated on small, single-engine airplanes, letting Boeing and Douglas build large, multiengine aircraft.

1915

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■ C-700  
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Navy biplane

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■ DM-1  
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■ Y1B-9/99  
■ P-25

■ Gamma  
■ Model 247

■ DC-1  
■ Stearman  
Kaydet

▲ North American founded  
▲ UATC split up; Boeing Aircraft Co. reestablished

1936



# *The early years*

*1923-1939*



## THE BOEING AIRPLANE COMPANY

"We have already proved that science and hard work can lick what appear to be insurmountable difficulties."

—William Boeing

The Boeing Airplane Company ended 1922 in a race with the Curtiss Aeroplane and Motor Company to design the best pursuit fighter. Curtiss finished its design first, in January 1923, and was awarded the first Army Air Service contract. Nonetheless, after the Boeing Model 15 (PW-9) prototype made its first flight six months later, military sales of the Model 15 and its derivatives made Boeing a leading producer of fighters for the next decade, culminating with 586 fighters in the F4B/P-12 series.

Boeing also produced the Model 40 mailplane in 1925 and, two years later, redesigned it as the Model 40A, adding a two-seat passenger cabin.



Charles Lindbergh's first solo nonstop transatlantic flight in a Ryan monoplane in 1927 sparked a tremendous surge of interest in aviation and an increase in airplane manufacturers. The U.S. government put its transcontinental mail routes up for bid.

Powered by a much lighter air-cooled engine than its predecessor, the Boeing Model 40A won the U.S. Post Office contract to deliver mail and maintain the airports this service needed between San Francisco and Chicago.

Boeing Air Transport (BAT) was formed to run the new airline. Philip G. Johnson was president, Claire L. Egtvedt was general manager, and William E. Boeing was chairman of the board. BAT also trained pilots, set up airfields, and staffed maintenance facilities for the new air mail service.

Bertha Boeing, William's wife, inaugurated the first BAT airmail flight July 1, 1927. Because of Prohibition, she performed the ceremony with orange-juice-flavored soda water, which she said "made a satisfactory fizz." Jane Eads,

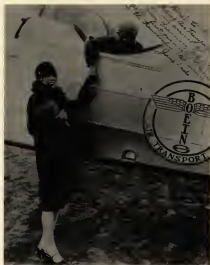
a reporter for the *Chicago Herald Examiner*, was the first BAT passenger. Elegantly garbed in high heels, a knee-length business suit, and a feather boa, Eads made the 22.5-hour trip from Chicago to San Francisco in a cabin not much bigger than a freezer.

During its first year, BAT carried 837,211 pounds of mail, 149,068 pounds of express packages, and 1,863 passengers. The popularity of passenger flight inspired the 12-passenger, three-engine Model 80 biplane, the first Boeing plane built specifically as a passenger transport. It made its first flight July 27, 1928, and, a year later, was upgraded to the 18-passenger Model 80A.

Over the years, Boeing had developed a close business relationship with Fred Rentschler, president of Pratt & Whitney, manufacturer of the air-cooled engine that made the Model 40A such a success as a mail and passenger transport. In 1929, Rentschler and Boeing set up a new holding company called the United Aircraft and Transport Corp. (UATC). Rentschler swapped ownership of Pratt & Whitney for 800,000 shares in the new concern, and Boeing turned over his shares for the new United stock.

The Boeing Airplane and Transport Corporation became UATC on Feb. 1, 1929, with Boeing as chairman and Phil Johnson as president. The shares became worth millions, and soon UATC absorbed other aircraft concerns.

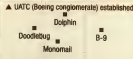
These included the Stearman Aircraft Company in Wichita, Kan., and Boeing Aircraft of Canada. Stearman built speedsters and commercial biplanes that could be adapted either for land or for sea. In contrast, the Canadian company had been the Hoffar-Beeching shipyard in Vancouver, B.C., building yachts, fishing boats, and ferries. After the shipyard was bought by Boeing, it added Model 40A mailplanes to its product lines. It continued to build boats, including William Boeing's 125-foot yacht, the *Taconite*.



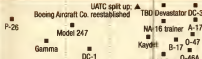
1923



1929



1935



1941





resigned his presidency of United Aircraft and Transport and went to Canada to help establish Trans-Canada Airlines.

Claire Egtvedt, who had been named president of the Boeing Airplane Company in 1933, took over the chairmanship as well as the presidency and decided to build the "Big Boeings." He believed that the company's future lay in large bombers developed in tandem with equally large passenger airplanes.

In 1934, the Army Air Corps wanted a very heavy, long-range experimental bomber, so Boeing engineers developed the XB-15, a four-engine aircraft with a wingspan of 149 feet. At the same time, they began the four-engine Model 299, prototype of the B-17 Flying Fortress bomber that would fill the skies during World War II.

The big bombers' features were incorporated in the four-engine Model 314 Clipper, a luxurious flying boat that would make the first scheduled transatlantic airplane flight, and in the commercial Model 307 Stratoliner, the first pressurized airliner. The Clippers and the Stratoliners attracted air travelers around the world. During 1940, more than 2.2 million people flew 150 million air miles.

#### DOUGLAS AIRCRAFT COMPANY, INC.

*"California has long been a place where I wanted to live ... because I have felt if there is to be any civil aeronautics, it will be there that it will first attain real success."*

—Donald Douglas Sr.

In 1922, Douglas produced six airplanes. Six years later, incorporated as Douglas Aircraft Company, Inc., the company was producing 120 aircraft a year. The company's first venture into light aircraft was the Douglas Commuter, finished in January 1926. Its wings could be folded back, along the side of the fuselage, so it could be stored in a garage, but it found no market.

By 1929, Douglas had finished building a new plant in Santa Monica adjacent to the Clover Field runway—until that time Douglas had to tow its aircraft a mile to the runway. By the end of that year, Douglas stock was among the highest valued in the industry.

After moving to its new facilities, the company continued making

observation biplanes and built its first twin-engine aircraft, the T2D-1 torpedo bomber. The company also built the PD-1, a Navy patrol bomber, delivered in May 1929.

In 1930, at the start of the Great Depression, Douglas built a small, but luxurious, commercial amphibian called the Sinbad. It found no commercial buyers during those tough times, but was sold to the Coast Guard. Its next version, the Dolphin, did much better and became the best known of all the Douglas-built amphibians.

As a result, despite the Depression, workers in the Santa Monica factory kept a steady pace turning out 59 Dolphins, 25 PD-1s (Douglas flying boats), 83 O-25 observation planes, 196 BT-2 trainers, and 162 O-38 scout planes.

Meanwhile, Douglas engineers, like their counterparts at Boeing, were exploring ways to build better monoplanes. They developed the gull-winged, single-engine observation monoplane, the XO-31, and the twin-engine XB-7 monoplane bomber; both first flew in 1930. The XB-7 and the O-43 and O-46, later versions of the XO-31, helped prepare the company to bid for the transport that would establish Douglas in commercial aviation history.

After the Boeing company told TWA's Jack Frye that he had to wait for the Boeing Model 247 twin-engine transports, two companies responded to the airline's request for bids for a tri-engine transport: Douglas and General Aviation.

Douglas lobbied hard for the twin-engine configuration and won. He assigned a team led by Harry Wetzel, Dutch Kindelberger, and Arthur Raymond to produce the DC-1. Its production version, the DC-2, became the aircraft of choice for many of the world's largest airlines.

In 1932, Jack Northrop returned to Douglas to run a majority-owned subsidiary and build all-metal monoplanes at a plant in El Segundo, now the site of Los Angeles International Airport.



1923

1929

1935

1941

▲ UATC (Boeing conglomerate) established

UATC split up: ▲

▲ McDonnell Aircraft Corp. founded

DT  
bomber

PW-9  
fighter

XO-2  
observation plane

PS-1  
The Commuter

T2D-1  
Model 40A

Model 80  
F4B/P-12

Doodiebug  
Monomail

B-9

Model 247  
Gamma

P-26  
DC-1

Model 247  
DC-1

Model 247  
DC-1

Model 247  
DC-1

Model 247  
DC-1

Model 247  
DC-1

Model 247  
DC-1

Model 247  
DC-1

Model 247  
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Model 247  
DC-1

Northrop had worked for Douglas in 1923 but left for Lockheed in 1927 to design the famous Vega, a single-engine transport. Later, in his own laboratory, Northrop built and tested a flying wing and produced the Northrop Alpha, widely used on TWA's transcontinental mail route.

Back with Douglas, Northrop produced the next in the series, the Gamma in 1932 and the Delta in 1933, selling 12 Deltas and 61 Gammas. The Gamma broke speed records, became a flying laboratory, and made an epic flight across the Antarctic.

In 1936, Northrop produced the A-17 attack bomber for the Army Air Corps, originally designed for export, and, in 1935, started building 56 BT-1 dive bombers for the Navy. With their perforated wing flaps, the BT-1s were immediate forerunners of the Dauntless dive bomber.

The next Douglas transport, the DC-3, was first delivered in 1936. Toward the end of 1934, C.R. Smith, American Airlines's new president, asked Douglas for a stretched, widened DC-2 that could include Pullman-type berths for transcontinental "sleeper" services. Douglas agreed and came out with the Douglas Sleeper Transport, which first flew Dec. 17, 1935 – the 32nd anniversary of the Wright brothers' first flight. The day-plane version of the DC-3 had two rows on one side of the aisle and one on the other. The DC-2 had two rows, with every passenger by a window. The DC-3 revolutionized the aviation industry by making air transportation more affordable and more profitable.

As the decade ended, World War II had already begun in Europe. The demand for commercial aircraft soon gave way to military production.

Douglas engineers used the DC-2 airliner as the basis for the B-18 Bolo bomber, and the B-23 Dragon bomber flew on the DC-3 wing.

In 1938, Douglas bought out the Northrop Corp., in which he already had controlling interest, and changed the name to the El Segundo Division of Douglas Aircraft Company. Jack Northrop left Douglas and, a year later, went on to found the Hawthorne-based business Northrop Aircraft, Inc.

#### MCDONNELL AIRCRAFT CORP.

*"Our objective is to be of maximum service possible to the United States government in the design and manufacture of airplanes ... We are going to operate as a constructive influence in this industry."*

—James S. McDonnell

As Douglas became nationally recognized, McDonnell, on the East Coast, was just starting out.

In 1925, McDonnell earned his master of science in Aeronautical Engineering from MIT. In the meantime, he had enrolled in the Commissioned Reserve of the Army Air Service to become a qualified pilot. He earned his wings as a pilot in 1924.

After his release from the Army, McDonnell went job hunting and, in 1924, was hired as an aeronautical engineer and pilot for the Huff Daland Airplane Company in Ogdensburg, N.Y. He then found work as assistant chief engineer with Henry Ford's Aviation Division of the Ford Motor Company, where he helped design the durable Ford trimotor Tin Goose.

In 1926, he left Ford and spent two years as chief engineer with the Hamilton Aero Manufacturing Company – which, by 1929, was part of the corporation owned by Boeing.

McDonnell left Hamilton in 1928 to establish his first company, called J.S. McDonnell & Associates, operating out of the Hamilton factory in Milwaukee, Wis. There he built his first airplane – the Doodlebug, which made its first flight Nov. 15, 1929.

McDonnell wanted to enter his two-place monoplane in the Daniel Guggenheim Safe Aircraft Competition and win \$100,000 – enough to set him up in business. He dreamed of selling personal airplanes to



1923

1929

1935

1941

DT bomber  
PW-9 fighter  
XO-2 observation plane  
PB-1  
The Commuter  
Model 40A  
T20-1  
Model 80  
Doodlebug  
Monomail  
B-9  
F4B/P-12  
UATC (Boeing conglomerate) established

Boeing Aircraft Co. reestablished  
Model 247  
DC-1  
UATC split up;  
reestablished  
TBO  
Naval trainer  
A-17  
Kaydet  
B-17  
B-24  
F-26  
Gamma  
Model 247  
DC-1

XB-15  
Stratoliner  
Model 314  
B-25

▲ McDonnell Aircraft Corp. founded



every family in America, the way Henry Ford sold his cars. Unfortunately, the horizontal tail of the Doodlebug folded, and it crashed. McDonnell rode the airplane to the ground and suffered severe damage to his back, and all his hopes of winning were dashed.



The Depression was under way. American families were more interested in buying food than airplanes. McDonnell's dream was clearly impossible. McDonnell dissolved his company and found employment, first with a Chicago firm as

a consulting engineer and then with the Great Lakes Aircraft Corp. as an engineer and test pilot.

In mid-March 1933, just a few days after Franklin Roosevelt's first inauguration, McDonnell went to work for Glenn Martin's aircraft company, now relocated in Baltimore, Md. He was chief project engineer for landplanes—the same job Douglas left 13 years prior. Under McDonnell's guidance, the well-known Martin B-10 and B-12 bombers were developed.

In December 1938, James McDonnell decided to start another company. He incorporated the McDonnell Aircraft Corp. in 1939 and, with 15 employees, set up shop at Lambert Field near St. Louis, Mo. The site was a major airline hub and could provide plenty of business for an enterprise that repaired and built airplanes.

"At the end of the first year, our backlog was zero, sales zero, earnings zero," McDonnell later recalled. The company's first production order was for \$7,672 worth of parts for Stinson observation planes.

By March 1940, McDonnell was included in the list of manufacturers invited to submit proposals for fighter construction. McDonnell's Model 1, a pusher-propeller aircraft, lost the bid, but his second submission gave him the funds to build two XP-67 Bat prototypes.

## NORTH AMERICAN AVIATION, INC.

*"I fed them beer and crab cakes and lectured to them on the marvels of the West."*

—Dutch Kindelberger

By the end of 1935, North American Aviation had 82 airplanes on order and employed 496 people. By the end of 1936, the company employed 991 people. The company also made its first overseas sale, a basic combat demonstrator for the Netherlands.

North American Aviation began to make its name as a manufacturer of trainers with the production version of the NA-16, the NA-19, which first flew April 15, 1936. The NA-19 led to 267 BT-9 basic trainers, including the Yale trainers built for Great Britain. The last variation of the Yale family was the BT-14, the first of which flew Feb. 10, 1939; 214 BT-14s were built.

The company also built 300 BC-1 "basic combat" trainers, including 30 BC-11 instrument trainers.

In 1936, the company built its first tactical aircraft, the O-47. It sold 238 of the pot-bellied, three-place scout planes that would become standard observation equipment in most units of the Army Air Corps.



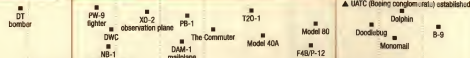
The onset of World War II created a nationwide need for bombers. Boeing started building B-17 Flying Fortresses, and Douglas produced its Bolo bombers.

NAA's initial multiengine bomber was the powerful NA-21 twin-engine Dragon bomber, which made its first flight on Dec. 22, 1936. The high-altitude bomber was generally admitted to be ahead of its time and was, in fact, a precursor to the B-25 Mitchell medium bomber that NAA built during World War II. The NA-21 did not see combat, but served out its years as a flight laboratory and was used for high-altitude development testing.

1923

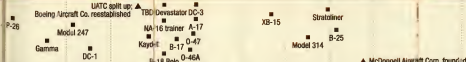
1929

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1935

1941







*The  
war years*

*1939–1945*

## THE BOEING AIRPLANE COMPANY

*"To an airman, the Pacific Northwest is the home of the long-range heavy bomber, which has changed the character of war and the meaning of peace."*

—General Carl Spaatz, Commanding General, U.S. Air Force, 1947

The United States entered World War II only 16 months after Boeing introduced the Stratoliner. Sales of commercial transports came to a halt. Suddenly, the country needed warplanes, produced quickly, collectively, and in quantity. Cooperation, rather than competition, between aircraft manufacturers made the best use of the country's resources for a united front.

Phil Johnson returned to Seattle from Canada and took over as the Boeing company president. He also was in charge of coordinating countrywide, multi-company mass production of bombers. He died of a stroke Sept. 14, 1944, while overseeing operations at the Boeing Wichita plant.

During 1935, in response to an Army request for a large, multiengine bomber, Boeing had financed the design of the Flying Fortress prototype, the B-17 (Model 299).

The B-17 went from drawing board to flight test in less than 12 months. The low-wing, four-engine monoplane bomber combined aerodynamic features of the XB-15 giant bomber, still in the design stage, and the Model 247 transport.



By the 1940s, Boeing workers were building B-17s at a rapidly increasing rate. After the start of World War II, burlap houses and chicken-wire lawns camouflaged the rooftops of Boeing Plant 2 in Seattle so that, from the air, the bomber manufacturing center looked like a quiet suburb.

As American men went to war, women built airplanes. Thousands of women, symbolized by "Rosie the Riveter," took up the slack in the workforce and helped boost production from 60 planes per month in 1942 to

an astounding 362 planes per month by March 1944. At one point, the Seattle plant rolled out 16 B-17s in 24 hours.

Boeing started producing the B-29 bomber in 1943, both in Wichita, Kan., and at the Boeing Renton plant near Seattle. The new Superfortress entered combat less than two years after its first flight. It was pressurized for high-altitude flying, was the heaviest airplane in production, and had many new features, including guns that could be fired by remote control.

In Wichita, farm workers, homemakers, and shopkeepers built B-29s on 10-hour shifts, day and night, during what later became known as the "Battle of Kansas."

Under the coordinated nationwide war effort, B-17s were built at Boeing, Douglas, and Lockheed-Vega factories. B-29s were built at Boeing, Bell, and Martin.

In addition, between 1936 and 1944, Boeing built 240 Douglas DB-7B attack bombers for England and 140 A-20 attack bombers for the U.S. Army Air Force, 750 Waco-designed cargo and troop gliders, and 8,585 Kaydet trainers, first introduced at the Stearman Aircraft Company in Wichita in 1933. Boeing Aircraft of Canada built 362 PBV flying boats and amphibians designed by Consolidated Aircraft of San Diego and 16 British-designed Blackburn Shark torpedo aircraft for the Royal Canadian Air Force.

## DOUGLAS AIRCRAFT COMPANY, INC.

*"Although separated by miles and communities, we are one in purpose and policy .... To build the largest number possible of the best airplanes in the shortest possible time."*

—Donald Douglas Sr.

Between 1942 and 1945, Douglas built 29,385 airplanes, about 16 percent of all the U.S. airplanes produced. Peak wartime employment at Douglas was recorded at 160,000 workers.

Douglas had to build several new factories to meet wartime production requirements. The largest was at Long Beach, Calif., with more than 1,422,350 square feet of covered workspace – nearly as much as the Santa Monica and El Segundo plants combined. It was camouflaged with paint, patterns, trees,

1939

▲ AT-6  
Twin

▲ BT-14  
Tale

▲ DB-7/11-20  
Boulton Paul

▲ World War II begins in Europe

1941

▲ B-25  
SB2C/A-24  
Doolittle

Japanese attack Pearl Harbor ▲

▲ P-51  
Mustang

▲ B-17E

▲ C-47  
Skytrain

1943

▲ C-54

▲ A-26B-28

▲ Battle of Midway

▲ Gargyle

▲ C-97

▲ XP-67

1945

First nuclear bomb test ▲

▲ World War II ends ▲

▲ HW-1

▲ A24-1

▲ B-29s bomb Hiroshima and Nagasaki ▲

and shrubs. It was a "black out" facility with limited, light-proof access and was the country's first fully air-conditioned factory. During peak production, the Long Beach plant produced an airplane an hour.

The first airplane produced there was the C-47 Skytrain, among the most popular Douglas-built military transports. It was based on the DC-3 and rolled out Dec. 23, 1941.

More than 10,000 military DC-3s served the Army Air Forces, the Navy, and U.S. allies. These aircraft were most loved and collected a variety of names, including the Dakota, the Dak, the Tabby, the Gooney Bird, Spooky, and Puff the Magic Dragon.

The most-produced attack bomber during World War II was the twin-engine DB-7 (Douglas bomber 7). It was designated A-20 by the Army Air Forces and was known as the Havoc or, in Royal Air Force service, the Boston.

During the war, 7,477 DB-7/A-20s rolled out. They earned the reputation for getting their crews home, even when both crew and aircraft suffered crippling blows.

The Douglas Dauntless bomber was just as tough. On Dec. 10, 1941, three days after Japan bombed Pearl Harbor, a Navy Dauntless from the *USS Enterprise* sank the first enemy ship. Dauntless pilots contributed to the victory at the Battle of Midway by sinking four Japanese carriers. The Dauntless earned the distinction of having the lowest loss ratio of any U.S. carrier-based plane.

Another Douglas bomber was the Invader attack bomber, started in 1941 to take over from the A-20. The A-26/B-26 Invader was the only American combat aircraft to fly missions in three wars. After World War II, Invaders served as a front-line bombers during the Korean conflict and, later, during the Vietnam War.

Just before war broke out in Europe, United Airlines, now no longer part of the Boeing complex, had given Douglas \$300,000 to build the company's first four-engine passenger transport, the DC-4E (E for experimental). Also contributing financially to the new transport were TWA, American, Eastern, and Pan American airlines. There were 24 orders for the slightly smaller production model, the DC-4, when war necessitated the plane's

reconfiguration as the C-54 Skymaster military transport.

One C-54, nicknamed the "Sacred Cow," was the official presidential transport, serving both Presidents Franklin D. Roosevelt and Harry Truman.

During World War II, the Douglas plant in Chicago, Ill., produced the Skymasters while the plant in Oklahoma City, Okla., built C-47 Skytrains. The factory in Tulsa, Okla., rolled out Dauntless, Invader, and (Consolidated B-24) Liberator bombers; the B-17s were built at Long Beach.

Douglas also established a top-secret aircraft maintenance facility in Ethiopia to serve Allied air commands in North Africa and was among the first to start manufacturing missiles with the ROC I, a guided air-to-surface rocket, first tested in 1941.



#### MCDONNELL AIRCRAFT CORP.

*"We finally got a contract. It was just a tiny one, and of course we didn't make a nickel on it. But the boys did a good job, and we learned a lot."*

—James S. McDonnell

During World War II, McDonnell was primarily a subcontractor for established giants such as Douglas and Boeing.

By 1941, there were 400 people on the McDonnell Aircraft Corp. payroll. During the war, it built ammunition boxes, gun turret parts, engine cowlings, and tail assemblies.

McDonnell continued working on designs for his own airplanes and, on Oct. 29, 1941, was contracted to build the XP-67 fighter. Known as the Bat because of its shape, or Bomber Destroyer because of its mission, the XP-67 was finished in St. Louis in December 1943, but its first flight did not take place until January 1944.

Unfortunately, the temperamental experimental engines caused the airplane's first flight to last only six minutes. Problems continued with

1939

AT-6  
Tuscan

DB-7/A-20  
Boston/Havoc

BT-14  
Tale

▲ World War II begins in Europe

1941

B-25  
Mitchell  
SBD/A-24  
Dauntless

Japanese attack Pearl Harbor ▲

P-51  
Mustang

B-17E

C-47  
Skytrain

1943

C-54

A-26/B-26

XP-67

▲ Battle of Midway

B-29

1945

Gargoyle

XP-67

C-97

First military bomb test ▲

World War II ends ▲

Pt-1

AD/A-1

P-52/F-82

B-29s bomb Hiroshima and Nagasaki ▲

the engines, and the XP-67's top speed was much slower than required. The second prototype, therefore, was never finished.

However, as early as 1940, McDonnell engineers had been researching the use of jet propulsion. By the end of World War II, the Phantom I had made its first flight and started a long line of McDonnell jet fighters.

#### NORTH AMERICAN AVIATION, INC.

*"A company called upon to furnish military planes in peacetime could be relied on for an extraordinary effort in the event of an emergency; and the company's responsibility for National Defense is as direct and vital as that of the established armed forces."*

—Dutch Kindelberger

During World War II, North American Aviation forged new production records and built 41,000 airplanes.

On June 20, 1941, the Army Air Corps became the Army Air Forces. Hundreds of thousands of new pilots had to be trained immediately, and thousands of trainers were needed. NAA built the sprawling Dallas factory to



accommodate demand—hence the name Texan for the trainers built there. Because aluminum was in short supply, NAA built 2,970 Texans partially out of plywood. Many Texans continued to train pilots after the war. The rugged trainers went on to serve with American

military services for 25 years and in more than 30 foreign countries; those made for the British Commonwealth Nations were called Harvards.

U.S. World War II pilots trained in North American's Texan, and many flew North American's Mustang into battle. NAA designed and developed the NA-73, the P-51 Mustang prototype, in only 117 days, and it first flew on

Oct. 27, 1940. Initially designed for the British Royal Air Force, its primary mission was to escort bombers deep into Germany.

The Mustang's extremely efficient aerodynamics allowed it to outperform Germany's front-line fighters. The P-51 Mustangs served for many years after the war as squadron operational fighters and with combat-ready air reserve groups and were brought back to serve in Korea. In addition to their use in the United States and Britain, Mustangs were used by air forces in Australia, China, Israel, Italy, Switzerland, France, the Dominican Republic, South Korea, and South Africa.

NAA's World War II bomber was the twin-engine B-25 Mitchell medium-attack bomber that first flew Aug. 19, 1940. It was the first bomber deployed in all World War II combat theaters and among the first American bombers to sink Axis submarines.

The B-25 was in accelerated production when war was declared, and B-25s were on time to stop massive enemy offensives during the critical early months. The B-25s also were flown by the air forces of Britain, Russia, the Netherlands East Indies, and China.

At dawn, April 18, 1942, 16 B-25s made the first surprise attack on Japan during World War II. Known as the "Doolittle Raid" because it was commanded by Lt. Col. Jimmy Doolittle, the amazing effort made a significant impact on enemy strategy in the Pacific Theater.

The B-25s had to take off from the aircraft carrier *Hornet*, several hundred miles further from the target than had been planned, because they might have been spotted prematurely.

Without enough fuel to make it to planned recovery fields in China, the B-25s made their strikes nonetheless. Eleven of the crews bailed out, four crash landed, and the remaining B-25 made it to Vladivostok, Russia, where its crew was interned.

During the peak production periods of World War II, an airplane rolled off a NAA production line every 15 minutes. The company produced 9,498 B-25s, 15,498 trainers, and 15,586 P-51 Mustangs. During 1944, its sales neared \$700 million.

1939

■ T-16  
Texan  
DB-7/A-20  
Boston Harbor

■ B-17

Yale

▲ World War II begins in Europe

1941

■ B-25  
Mitchell  
Doolittle

Japanese attack Pearl Harbor ▲

■ P-51  
Mustang  
■ B-17E  
■ C-47  
Skytrain

1943

■ C-54  
A-26/B-26  
▲ Battle of Midway

■ B-29

■ Gargoyle  
■ C-97  
■ XP-67

1945

First and last bomb test ▲

World War II ends ▲  
■ F-81  
■ A-19A  
■ P-80F-82  
B-29s bomb Hiroshima and Nagasaki ▲





*Postwar  
innovation*

*1946-1954*



## THE BOEING AIRPLANE COMPANY

*"Paths open for the future are paths of opportunity for the aggressive, capable company in the aerospace field, offering multiple choices of endeavor .... The years ahead promise to be at least as challenging and revolutionary as those through which we have come."*

—William Allen

The years immediately following the end of World War II rocked with change. The military canceled its bomber orders; Boeing factories shut down, and 70,000 people lost their jobs. The same day the plants closed, attorney William M. Allen, somewhat hesitantly, took over as company president.

Allen promised to start hiring people back as soon as airlines ordered the Stratocruiser, a luxurious commercial airliner version of the company's four-engine C-97 military freighter, first flown in 1944.

Unfortunately, the elegant Stratocruiser was not the hoped-for financial breakthrough. It lost out to its Douglas counterpart, the DC-6. What contributed

most to the Boeing company coffers was adapting the C-97 as the KC-97, an aerial tanker using the Boeing-developed flying boom for in-flight refueling. The flying boom was tested in the Kansas skies in 1948 on converted B-29 bombers. Equipped with V-shaped control surfaces, the boom was actually "flown" into position on the receiving aircraft, making it easier to transfer fuel under a variety of wind and weather conditions. This allowed the Strategic Air Command to place tankers and bombers anywhere in the world and extended the range of existing military aircraft.

The KC-97 became the Air Force's prime aerial tanker until it was replaced by the jet-powered KC-135.

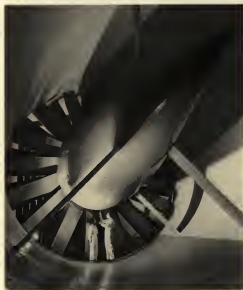
In fact, the KC-97 was the last propeller-driven plane built by Boeing. By the late 1940s, technology would advance to the point of making the jet engine practical.

Wind-tunnel data discovered in Germany as the war ended helped Boeing engineers design the country's first operational multiengine, swept-wing jet bomber, the B-47 Stratojet. The B-47 was a revolution in aircraft design, and all modern jet aircraft use the swept wing that it established.

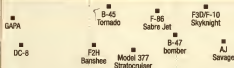
The B-47 bomber was the first Boeing airplane to use the new Boeing high-speed wind tunnel, the largest privately owned facility of its type, to test design solutions to the problems of combining jet propulsion with a slender, swept-back flexible wing. Completed in 1944, the tunnel was dedicated to Edmund "Eddie" Allen, test pilot and chief of Boeing Flight and Research from 1941 until his death in 1943 in the crash of a B-29 during testing.

The B-47 was followed by the B-52, the country's first long-range, swept-wing heavy bomber, which became the mainstay of the U.S. bomber force. B-52s were instrumental during the Vietnam War and served during Desert Storm using Boeing-built conventional air-launched cruise missiles (CALCM).

Another significant innovation after the war was the increased use of computers. Analog computers had been used to guide the flight of guided missiles in the 1940s, including the Boeing Ground-to-Air-Pilotless Aircraft (CAPA). These early computers were very large and cumbersome but soon were part of the process of building Boeing airplanes and, later, were used to design more advanced missiles and rockets, including Bomarc, the company's first mass-produced missile.



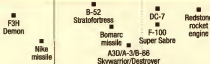
1946



1949



1952



1955



GAPA was the 16-foot, needle-nosed, solid-fuel supersonic rocket developed in response to German buzz bombs. It laid the groundwork for mass production of missiles during the ensuing Cold War years.

During World War II, missile, jet, and electronic technologies were developed for use in battle. Afterward, they launched the jet and the space age.

#### DOUGLAS AIRCRAFT COMPANY, INC.

*"Scientist and mechanic alike have a heritage and tradition with which there is no compromise. Together they work; together they plan ahead and look ahead."*

—Donald Douglas Sr.

On Oct. 24, 1945, two months after the end of World War II, envoys from 50 countries around the world created the United Nations, an organization dedicated to saving succeeding generations from the scourge of war.

The world had to meet the challenge of peace. It meant the end of most military airplane production. It also meant airplane companies needed to work harder to serve the civilian population.

Within six months of the end of World War II, Douglas had trimmed its workforce by 99,000, closing the plants in Oklahoma City, Tulsa, and Chicago.

Not only did the war's end bring cancellation of government aircraft orders, it also created huge surpluses of aircraft. The Douglas company found itself competing against converted C-47s and C-54s, the same planes it produced during the war.

Douglas reorganized its three remaining plants along customer and product lines. Santa Monica became the center for producing commercial transports and their military derivatives, El Segundo for naval aircraft, and Long Beach for Air Force programs.

As the war ended, Douglas developed a pressurized version of the C-54 Skymaster that was more than 80 inches longer and had large rectangular windows, rather than round portholes. It made its first flight Feb. 15, 1946. It evolved into Douglas' first new postwar passenger transport, the DC-6, using four Pratt & Whitney engines that were twice as powerful as those used on the DC-4/C-54.

The DC-6, like its Boeing equivalent, the Model 377 Stratocruiser (based on the C-97 military transport), was advertised as being able to "fly over the weather."

Once again, Douglas and Boeing were competing for sales to airlines.

To help market the new airplane, Douglas public relations staff

photographed models inside the

DC-6 cabin. Among them was

Norma Jean Baker — before she was known as Marilyn Monroe.

Douglas won out. The demand for the DC-6 vastly exceeded sales estimates. During its 11-year production run, Douglas delivered 537 DC-6s, plus 167 military versions, the C-118s.

In May 1953, Douglas introduced the DC-7, a larger and faster airplane than its predecessor. It could fly anywhere in the world, so the DC-7C was called "The Seven Seas"; 338 DC-7s were produced between 1952 and 1958. By the mid-1950s, Douglas was again leading the commercial aircraft industry.

But time and technology change, and the DC-7 was the last Douglas commercial propeller-driven airplane and the last built at the Santa Monica plant. The next battle for business in the commercial sector would be in the jet stream.

The C-74 Globemaster, a propeller-powered military transport, made its first flight Sept. 5, 1945. The gigantic C-74 could circle the world with only two stops and was test flown at a gross weight of 86 tons, the greatest weight to leave the earth under controlled power at that time.

Douglas built only 14 of these; they were superseded by the even larger C-124, or Globemaster II, delivered in May 1950, a month before the start of the Korean conflict. Douglas built 448 Globemaster IIs.

The last Douglas propeller-powered military transport was the C-133 Cargomaster, with a circular fuselage and top-mounted wings. After delivery of the last Cargomaster in 1961, Douglas did not design and build another



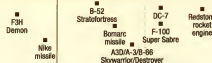
1946



1949



1952



1955



military transport for 10 years.

Instead, the company found incredible success with its popular medium bomber, the AD Skyraider.

Douglas sold more than 3,000 Skyraiders, the product of an all-night

alteration of an existing design study that had been ongoing by the El Segundo advanced design section headed by Douglas chief engineer Ed Heinemann. After a meeting with top Navy officials in Washington, D.C., Heinemann was given less than 30 hours to come up with a design that could get Douglas back in the lead building Navy attack bombers. Heinemann, chief designer Leo Devlin, and chief aerodynamicist Gene Root holed up in a hotel room and came up with the Skyraider, a brand-new airplane to replace the Dauntless dive bomber.

During the Korean conflict, Skyraiders entered service over the Korean Peninsula in October 1951 and, by 1955, 29 Navy Skyraider squadrons were in place. When war broke out in Southeast Asia, Skyraiders served with the U.S. Navy and both U.S. and South Vietnamese air forces.

Despite the accomplishment of the Skyraider, its sibling, the A2D Skyhawk, was not as successful. The turboprop-powered Navy attack bomber, with a tapered nose and streamlined shape, first flew on May 26, 1950, but could not surmount engine problems.

Another postwar development was the "think tank." It began at Douglas during the war as Project RAND (Research and Development) under General "Hap" Arnold. In 1948, the Air Force transferred the staff to the newly independent RAND Corp.

The new science of jet propulsion was the focus of many studies and, in 1948, the Navy asked RAND, as well as other "think tanks," to see if it was feasible to build a jet-powered, carrier-based strategic bomber. These bombers usually required longer runways than carriers could supply and had to be large

enough and powerful enough to carry a five-ton nuclear bomb. Douglas met the challenge by producing the bomber that became the Navy's A3D Skywarrior and the Air Force's B-66 Destroyer. It entered service in 1956 and proved useful to both services for reconnaissance and for electronic countermeasures, but was never used as a bomber.

The first Douglas fighter to enter service was the first jet fighter ordered by the Navy strictly for use as a night fighter. Originally conceived during World War II, the straight-wing F3D Skyknight fighter first flew March 23, 1948, and was stationed with land-based Marine units in Korea. It remained in service as a reconnaissance and electronic countermeasures aircraft for 20 years.

The Delta-wing Douglas F4D Skyray was started at about the same time as the Skyknight, but it used the German delta-wing wind-tunnel data found after the war. More than 420 Skyray fighters were built.

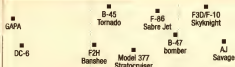
The enormously successful Douglas A4D Skyhawk light-attack jet bomber first flew in 1954. Built small to be cost effective and so that more could be accommodated on a carrier, many called it the "Scooter." The last Skyhawk was delivered in February 1979, ending a 25-year, 2,960-aircraft production run. It was still active with several air services through 1998 and was scheduled to remain in service into the next century.

The next Douglas fighter was the F5D Skylancer, which flew April 21, 1956. The four Skylancer prototypes were turned over to NASA and used in early development of the Boeing X-20 Dyna-Soar space vehicle.

Douglas scientists continued to explore ways to fly aircraft faster than the speed of sound and came up with the experimental D-558 Skystreak, which first flew May 28, 1947, and almost crossed the sound barrier. It was beaten to that goal in October by Chuck Yeager in an Air Force X-1 research airplane built by the Bell Aircraft Company.



1946

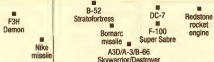


1949



Korean conflict

1952



1955



Douglas' experimental airplanes also included the D-558-2 Skyrocket that was carried aboard a B-29 bomber, released at 35,000 feet, and clocked at 1,238 mph. A little later, the Skyrocket was the first aircraft to fly at Mach 2.

In 1954, Douglas proposed building the D-558-3 for the Air Force. The D-558-3 was never built, but it would have been able to reach a velocity many times the speed of sound. A few years later, the hypersonic thread was picked up by NAA, with its X-15 rocket plane. At the same time, Douglas built the aptly named X-3 Stiletto, which rolled out in 1952 but proved to be underpowered for its hypersonic mission.

However, while Boeing and Douglas, during the late 1940s and early 1950s, began to explore the potential of the new science of jet propulsion, they survived the postwar depression by mass producing propeller-powered aircraft.

#### MCDONNELL AIRCRAFT CORP.

*"It is going to be extremely interesting in the 20 years to come. While continuing our work in aeronautics, we must also go into missiles and space, and it will be just as hard to do that as it was starting... But we will do it successfully."*

—James S. McDonnell

McDonnell had a different type of adjustment after World War II ended. His was a small company that was primarily a supplier of airplane parts. McDonnell realized he would have to compete by risking more and going further. He was willing to build smaller airplanes that took advantage of new and untried technologies.

His engineers' research into jet technology paid off Jan. 1, 1943, when Navy officials asked McDonnell to design and build a jet fighter. Jet power would fuel McDonnell's climb to prominence.

The XF1D-1, prototype for the FH-1 Phantom jet fighter, was the second airplane designed by McDonnell's little aircraft company. It first flew Jan. 26, 1945. Its name dated back to McDonnell's Princeton days and his keen interest in the spirit world.

The Phantom was the fastest Navy combat airplane to fly during World War II, and 62 were built. With it, McDonnell began a long association with the Navy as the prime supplier of carrier-borne jet fighters. That first FH-1 Phantom was the precursor of the F-4 Phantom II, made famous during the Vietnam War and which could fly more than twice the speed of sound.

On July 21, 1946, operating from the *USS Franklin D Roosevelt*, an FH-1 Phantom became the first jet-propelled aircraft to take off and land on an American aircraft carrier. By May 1948, the first all-jet squadron aboard the *USS Saipan* was operational with FH-1 Phantoms.

McDonnell continued to name his airplanes after mythical beings. The Phantom was followed by the experimental tiny XF-85 Goblin, a parasite fighter designed to be stowed aboard a bomber. It first flew in 1948, but test pilots found it hard to hook the Goblin in flight to the host bomber's trapeze during its "recovery" process. Only two were built.

McDonnell improved on the Phantom with the faster and larger F2H Banshee. The company built 895 Banshees, and the fighter established McDonnell as a new star in the U.S. aircraft manufacturing industry. The Banshee went into combat over Korea in 1951 and served with the Navy and the Marine Corps until September 1959. It was a multimission aircraft, used as a day fighter, as a night fighter, and for photoreconnaissance.



1946

GAPA

DC-6

B-45  
TornadoF-86  
Sabre JetF3D-F-10  
SkyknightB-47  
bomberModel 377  
StratocruiserAJ  
SavageNA-150/F-28  
TigraC-124  
Globemaster II

Korean conflict ▲

1949

1952

F3H  
DomenNike  
missileB-52  
StratofortressBomarc  
missileDC-7  
F-100AJ30/A-3B-66  
Skywarrior/DestroyerAJ30/A-3B-66  
Skywarrior/DestroyerAJ30/A-3B-66  
Skywarrior/DestroyerAJ30/A-3B-66  
Skywarrior/DestroyerAJ30/A-3B-66  
Skywarrior/DestroyerAJ30/A-3B-66  
Skywarrior/DestroyerAJ30/A-3B-66  
Skywarrior/DestroyerAJ30/A-3B-66  
Skywarrior/DestroyerAJ30/A-3B-66  
Skywarrior/DestroyerAJ30/A-3B-66  
Skywarrior/DestroyerAJ30/A-3B-66  
Skywarrior/DestroyerAJ30/A-3B-66  
Skywarrior/DestroyerAJ30/A-3B-66  
Skywarrior/Destroyer

1955



Banshees were followed by Demons; the first of 522 F3H Demons rolled off the St. Louis production line in 1951. The Demon was one of the first aircraft designed for missile armament rather than guns and, in 1958, the Demon became the first carrier fighter to fire air-to-air guided missiles while deployed at sea.

The Voodoo followed the Demon; the first of 807 F-101 Voodoos flew on Sept. 29, 1954. At the time, the Voodoo was the fastest tactical fighter in service.



On Dec. 12, 1957, it captured the world speed record of 1,207 mph. The multimission F-101 Voodoo was built as a long-range attack fighter, as an interceptor, and for photoreconnaissance. It was

used by three U.S. Air Force Commands - Strategic, Tactical, and Air Defense.

Just after the war, McDonnell began to build helicopters with less mysterious names, but they were not as successful. In 1942, he invested in the Platt-LePage aircraft company, building the XR-1, the first helicopter ordered by the Army Air Forces. Its vibration problem kept it out of production. A year later, McDonnell started the Navy XHJD-1 Whirlaway. The single prototype had two main rotors mounted on short wings. When it was completed in 1946, it was the largest helicopter ever flown.

The next McDonnell rotorcraft was the tiny *Little Henry*, which first flew in 1947, a year after Platt-LePage was liquidated. In 1950, McDonnell initiated development of a ramjet-powered utility helicopter called the Model 79, nicknamed *Big Henry*. None of the helicopters the McDonnell Aircraft Corporation built between 1946 and 1957 ever went into production.

The jets took center stage. By the end of the Korean conflict, the McDonnell Company had catapulted from a parts supplier to a leading manufacturer of carrier-based jet aircraft.

# NORTH AMERICAN AVIATION, INC.

*Development, the bridge between conceptual thought and hard work ... is the heart of North American activities.*

—Lee Atwood

There were orders in the North American Aviation's books for 8,000 airplanes as World War II ended. A few months later, after postwar cancellations, there were orders for only 24 airplanes. The Dallas and Kansas City plants were closed, and the company began to study conversion to civilian hardware.

NAA entered the unfamiliar habitat of private commercial aircraft with the Navion, which cost \$10,000 to build but was priced at \$7,000. The Navion cost the company \$8 million before the project was sold to the Ryan Aeronautical Company in 1947.

The company did better with its military product lines. The AJ Savage bomber, a propeller-powered, high-speed, carrier-based atomic bomber, first flew in the summer of 1948. Built for the Navy, the Savage was the largest airplane at the time operating aboard aircraft carriers.

However, like their counterparts at the Boeing, Douglas, and McDonnell aircraft companies, North American managers knew the era of the piston engine was passing quickly, and jets would soon be in the mainstream. In 1947, NAA produced the B-45 Tornado bomber, which was the Air Force's first operational multijet bomber.



The Tornado served as an airborne deterrent with NATO forces into the 1950s. It was the last of the "straight wing" bombers in the U.S. military, and only 143 were built.

NAA's FJ-1 Fury, a carrier-based Navyjet, started out with straight wings, but later versions had swept wings, higher maximum altitudes, faster speeds, and greater range than the earlier models.

1946

G4N

DC-6

B-45  
Tornado

F-46  
Sabre Jet

F3D-F-10  
Skyknight

B-47  
bomber

AJ  
Savage

F3H  
Banshee

Model 377  
Stryker

C-124  
Globemaster II

N-159/F-28  
Tiger

Korean conflict

F3H  
Dutton

Nike  
missile

1952

B-52  
Stratofortress

Bomarc  
missile

DC-7

F-100  
Super Sabre

Redstone  
rocket engine

ASDA-35-66  
Skywarrior/Destroyer

1955



NAA's use of the captured German wind-tunnel data led to the development of the world-famous Sabre Jet, America's first swept-wing fighter. The resulting family of Sabre Jets became the top-performing jet fighters of their time.

All 39 United Nations jet aces during the Korean conflict won their laurels in Sabre Jets.



NAA alone produced more than 4,300 F-86 Sabre Jets. The increasing demand for Sabre Jets required more manufacturing space, so North American leased a Naval Industrial Reserve Facility in Columbus, Ohio, which had been used as an aircraft production facility by Curtiss-Wright.

By the time the Korean conflict began June 25, 1950, the Air Force still had 1,804 F-51 Mustangs in service. The Mustangs flew a total of 62,607 missions in combat, but the Sabre Jet emerged as one of the decisive weapons in that conflict.

The Fifth Air Force Sabre Jets flew 236 sorties over Korea in December 1950, averaged 1,024 a month during 1951, 3,279 a month for 1952, and 5,045 a month for the first seven months of 1953. The Sabre Jet's kill ratio during that time was 10 to 1.

By the end of 1952, NAA sales topped \$315 million, and employment at the Columbus plant had gone from 1,600 in 1950 to 18,000.

The Columbus plant became one of NAA's most important facilities. During the next two decades, nearly all the company's naval fighters, trainers, and heavy-attack bombers were built there.

In addition, NAA was deeply involved with new missile and propulsion technologies. As soon as World War II ended, NAA was experimenting with

captured V-2 rockets and studying the potential of atomic power.

The NAA Aerophysics Laboratory was established in 1946 to study guided missiles and rocket engines. In 1947, the Aerophysics Laboratory was renamed Missile and Control Equipment (MACE) and moved to a new NAA plant in Downey, Calif.

MACE efforts in design, development, and production of missiles and their related guidance and propulsion systems, aircraft fire and flight control systems, nuclear reactors, and various electronic and electromechanical devices led to the formation of NAA's Rocketdyne, Autonetics, Missile Development, and Atomics International divisions.

North American scientists proposed a two-stage missile, for which the first stage would be a pilotless missile that would fly back to its base and land. By 1950, this had evolved into the Navaho cruise missile, followed by the GAM-77 Hound Dog missile carried on bombers.

The Downey plant would eventually become headquarters of North American's Missile Division, where Apollo spacecraft would be built.

In 1951, the Downey Science Workshop built one of the first water-boiler type of nuclear reactors. This led to the formation of Atomics International in 1955.

1946

GAPA

DC-6

B-45  
TornadoF3H  
DaggerModel 377  
StratocruiserF-86  
Sabre JetB-47  
bomberAJ  
SavageF3D/F-10  
SkyknightC-124  
Globemaster II

1949

NA-155/T-28  
Trojan

Korean conflict ▲

1952

F3H  
DemonNike  
missileB-52  
StratofortressBomarc  
missileASD/A-3/B-46  
Skywarrior/DestroyerDC-7  
Super SabreRedstone  
rocket engine

1955



# *Jets and rockets*

*1954-1971*

## THE BOEING COMPANY

*People thought we were crazy.*

—Juan Trippe, Pan American president, placing the first order for 707s, 1955

Boeing engineer Wellwood Beall had interesting news when he returned to Seattle in 1950 after delivering an order of Stratocruisers to British Overseas Airways Corp. The British had developed the world's first jet airliner, the de Havilland Comet. Although that particular plane never lived up to its

potential, Beall and the other Boeing engineers knew that jet airliners were the transport of the future.

By then, Douglas was dominating the U.S. market for propeller-driven transports. The time was right for Allen to take a chance on a revolutionary new



airplane. Such a risk had been taken before, on the B-17 bomber that catapulted Boeing into industry leadership.

In August 1952, the Boeing board of directors and company management decided to invest \$16 million (two-thirds of the company's net profits from the postwar years) to build the prototype for a new long-range jet-powered aircraft.

The prototype was designated the Model 367-80 to keep its construction secret, since the 367 designation also belonged to the propeller-powered C-97. Because Boeing had been so successful building and selling military tankers, engineers designed the Dash 80 prototype so that it could be the basis for the KC-135 aerial tanker as well as the 707 passenger transport.

The Dash 80 combined aerodynamic and structural features of the B-47 and the B-52 with the cabin capacity of a larger transport. Seventy-two-year-old William Boeing, his wife, Bertha, and a crowd of 8,000 were on hand for its rollout May 14, 1954.

Once again, Bertha Boeing christened an airplane that would introduce a new era of passenger service, only this time she used champagne.

It was a huge gamble to sink most of the company's profits into a single airplane. When test pilot Tex Johnston drew nationwide attention to the new jet's capabilities by taking it into a barrel roll over the Seafair hydroplane course on Lake Washington on Aug. 7, 1954, Boeing President William Allen reached for heart pills.

In September 1954, the Air Force ordered the first of more than 700 KC-135 aerial tankers. The KC-135 was the only jet airplane designed specifically for aerial refueling and, for 15 years, was the only tanker used by the Strategic Air Command; 552 were still in service in 1998.

In October 1955, Pan American World Airways ordered 20 707-120 jet transports. The race for dominance of the jet transport market was on, and Boeing was first out of the gate.

Using about 1/10th the fuel, the \$5 million 707 could carry as many transatlantic passengers a year as the \$30 million *Queen Mary* ocean liner.

As markets evolved, so did Boeing jets. Later versions used turbofan engines to reduce noise and increase range and power. The Boeing airplane "family" expanded to include the 727, the company's first trijet, designed for smaller airports with shorter runways. The early models of the 737 were initially designed as smaller, short-range,

twin-engine jets. The massive 747 jumbo jet was built when crowded airports and increased airline traffic indicated a need for an airliner with even greater payload capacity and range.

Some 707-120Bs, used to transport government officials, used the call sign "Air Force One" when the U.S. president was on board. In 1962, a Boeing 707-320B airframe was adapted specifically for use by the president, designated VC-137C, and called Air Force One. Two VC-137Cs served as the presidential aircraft until 1990, when they were replaced by 747-200 Air Force Ones (designated VC-25A).



1954

■ Skyhawk  
■ Model 367-80 Dash 80  
■ C-133 Cargo master  
■ Russia launches Sputnik  
■ F-101 Woodpecker

■ KC-135  
■ Model 707  
■ AS4U-3 Vigilante  
■ Thor missile  
■ F-4 Phantom  
■ F-2 DC-8  
■ Russian

1960

■ Military space capsule first ground flight  
■ Minuteman missile  
■ Omaha launch vehicle  
■ Gemini multi-man module  
■ Gemini multi-man module

■ Gemini multi-man module  
■ Gemini multi-man module  
■ Gemini multi-man module  
■ Gemini multi-man module

1966

▲ Vietnam War

■ Model 727  
■ Gemini multi-man module  
■ Gemini multi-man module

■ DC-8  
■ OV-10 Bronco  
■ Gemini multi-man module

■ Lunar Orbiter  
■ Saturn V launch  
■ Gemini multi-man module

1972

▲ Apollo spacecraft takes first humans to land on the moon



The military also used the 707 as the aircraft platform for the E-3 Airborne Warning and Control System (AWACS) and the E-6 submarine communication system.

By the early 1960s, engineers believed the

next generation of passenger airplanes would fly faster than the speed of sound. And, in 1966, the company won a government contract to develop America's first supersonic transport, the SST. Although it never went past the mockup stage, that first SST was a pioneer in an exploding world of new sciences.

During the 1950s and 1960s, companies and countries competed for first place in the emerging arena of high technology. The prize was the future. As aircraft manufacturers raced to build the best jets, nations battled to be the first in outer space and strove to defend their boundaries with the best missile systems.

CAPA, built in the 1940s, laid the groundwork for mass production of the 45-foot Bomarc missiles in 1957, intended to intercept invading enemy aircraft. As the Cold War continued through the 1950s, Boeing used its missile experience to design, build, install, and maintain the Minuteman intercontinental ballistic missile system, including its bases. The Minuteman project was one of the company's largest, longest lasting, and most complex military projects, and more than 39,700 people worked on it during its peak production.

Other Boeing engineers designed the Dyna-Soar, a crewed, reusable space vehicle that reached the mockup stage before the project was canceled in 1963. The concept reappeared 20 years later in the form of the Space Shuttle, built by North American Rockwell.

The Boeing shared legacy is epitomized by the Apollo program, which started in 1961 when President John F. Kennedy committed America to

landing a person on the moon before the end of the decade. Astronauts finally went to the moon in spacecraft designed and built by North American Rockwell. Apollo was launched by the 363-foot-tall Saturn V rocket, for which Boeing built the first stage; North American Rockwell, the second; and McDonnell Douglas, the third. The last Saturn V carried the McDonnell Douglas-built Skylab into space in 1973.

So NASA could select safe landing sites for the astronauts on the Apollo missions, crewless Boeing-built Lunar Orbiters circled the moon and sent photographs of its surface back to Earth. Boeing also built the Lunar Roving Vehicle astronauts used to explore the moon on the last three Apollo missions.

Coordinating the Apollo program were 2,000 Boeing executives on loan to NASA. Other employees provided overall systems integration. The first crewed Apollo flight, designated *Apollo 7*, was launched Oct. 11, 1968.

Much closer to Earth, the helicopter came into its own.

In 1960, Boeing bought the Vertol Aircraft Company, located in Philadelphia, Pa. Boeing tandem-rotor Chinook helicopters logged thousands of hours of combat service as the Vietnam War escalated.

Because principles that send things flying through the air (aerodynamics) are similar to those that send things skimming through water (hydrodynamics), Boeing applied many systems used by jets to Boeing hydrofoils, including the JETFOIL and Patrol Hydrofoil Missiles.

But even as new sciences soared, the market plummeted. By 1971, the industry was gripped by a recession that almost turned out the lights in Seattle.



1954

Skylark  
Model 367-80  
Dash 80  
F-101  
Voodoo

KC-135  
Navaho missile

Model 707  
A3J/A-5  
Vigilante

Thor  
missile

F-4  
Phantom

T-2  
DC-6  
Buckeye

Model 720  
G44-77  
Hound Dog  
missile

Delta  
launch vehicle

Minuteman  
missile

OH-47  
Chinook  
helicopter

Boeing purchases Vertol

Mercury space capsule  
first crewed flight

1960

1966

▲ Vietnam War

Model 727

DC-9

OH-6  
Cayuse  
helicopter

Lunar Orbiter

Saturn V launch

General spacecraft

1972

▲ Apollo spacecraft  
takes first humans  
to land on the moon



# DOUGLAS AIRCRAFT COMPANY, INC.

*"It was all done by judgment, mostly. If the airplane flew, the judgment was good. If it didn't fly, the judgment was bad."*

—Donald Douglas Sr., looking back 50 years

After 1955, Douglas found itself at the height of a sweeping postwar economic boom; the company had survived the postwar recession and was a leading manufacturer of commercial and military transports.

Donald Douglas Sr. decided to relinquish some responsibility for the massive company he had created 35 years prior. He had trained his son,



Donald Douglas Jr., to take over. The younger Douglas had studied engineering at Stanford University and at the Curtiss Wright Institute and had been vice president of the company after World War II.

In October 1957, Donald Douglas Jr. became president of the company,

although Donald Douglas Sr. remained chairman of the board.

The propeller-powered Douglas DC-7 dominated the commercial transport field well into the 1950s, and Douglas was committed to its production despite the airlines' growing interest in jet propulsion.

Moreover, the jet-powered transport, the British Comet, was grounded in 1954 after two crashes. The Douglas company hesitated to embark upon untested waters, particularly because its very successful DC-7 relied on stable, proven technology.

As a result, Douglas did not announce plans to build the DC-8 jet transport until after the Boeing Dash 80 first flew.

The DC-8 entered service with United and Delta Air Lines on Sept. 18, 1959, and set world records for speed, cargo capacity, and range. It was followed by the DC-9, which flew first in 1965.

The DC-9 entered airline service with Delta, two months ahead of schedule, and was the most successful Douglas transport since the DC-3. This time

Douglas beat Boeing to the tarmac. The popular DC-9 was out two years ahead of its Boeing competitor, the 737.

The DC-9 was converted into the C-9A Nightingale for the Air Force, into the C-9B Skytrain II for the Navy and the Marine Corps, and into three VC-9C Skytrain II executive transports.

During the 1950s, Douglas became deeply involved in missile systems and the ensuing, rapidly evolving space technologies.

The Douglas Roc I was followed by Roc II, a television-guided air-to-ground missile in the late 1940s, and, in the early 1950s, by an air-to-air missile, the Sparrow I. Douglas also built thousands of the MB-1 (later Air-2) Genie rockets that first appeared in 1957 and that equipped both American and Canadian interceptor forces into the 1980s.

Douglas opened a plant at Charlotte, N.C., specifically to build its first major operational missile system, the Nike; the first Nike Ajax missile was delivered in July 1956. It was followed by the Nike Hercules, the three-stage antiballistic Zeus, and the single-stage Honest John.

In 1959, Douglas was prime contractor for the Skybolt missile system shared by both the Air Force and the Royal Air Force; Skybolts were designed to be carried on B-52 and RAF Vulcan bombers. Douglas also worked with the Air Force to develop the Thor, the first intermediate-range ballistic missile (IRBM) deployed since the V-2.

The Thor IRBM was designed in eight months in 1956 and rushed off the Santa Monica assembly line. Thor was also used as the first-stage rocket to launch NASA's first (America's fifth) satellite into space Oct. 11, 1958, and continued to be used as a launch vehicle until 1981. Augmented by solid-fuel boosters, it became the Thor Delta launch vehicle for NASA and the Air Force.



1954

Skyhawk  
 Model 357-80  
 Dash 80  
 F-101  
 Voodoo  
 KC-135  
 Navaho missile  
 C-133  
 Carquester  
 Russia launches Sputnik  
 T-2 DC-8  
 Buckeye  
 Model 707  
 ASJA-5  
 Vigilante  
 F-4  
 Phantom  
 Hawk-77  
 Hound Dog  
 missile  
 Model 737  
 Delta  
 launch vehicle  
 Minuteman  
 missile  
 CH-47  
 Chinook  
 helicopter  
 Mercury space capsule  
 first crewed flight  
 Boeing purchases Vertol

1960

1966

Vietnam War  
 Model 727  
 On-6  
 Cayuse  
 helicopter  
 DC-9  
 OV-10  
 Bronco  
 Gemini spacecraft  
 Lunar Orbiter  
 Saturn V launch

1972

Apollo spacecraft  
 takes first humans  
 to land on the moon



**MCDONNELL DOUGLAS CORP.**

*"America is now a space-faring nation. This is a frontier good for millions of years.... The creative conquest of space will serve as wonderful substitute for war."*

—James S. McDonnell

After the war, McDonnell's company had gone from a small supplier of airplane parts to a leading manufacturer of combat aircraft, including the best-selling Voodoo and F-4 Phantom II fighters.

The Phantom II was a supersonic jet designed to perform every classic fighter mission ever conceived: as first-line interceptor, fighter bomber, escort,



and reconnaissance aircraft. It first flew May 27, 1958, and entered service in 1961. The Phantom set a speed record of 1,606 mph and an altitude record of 98,425 feet. In 1969, it was the only fighter to fly concurrently with both

U.S. military aerobatics flight demonstration teams – the Air Force Thunderbirds and the Navy Blue Angels. The last of the St. Louis-built Phantoms was delivered in 1979; they saw combat in both the Vietnam War and Operation Desert Storm and served with the air arms of 11 countries in addition to the U.S.

McDonnell also expanded his operation to include missiles and rockets. The company first entered rocketry in 1944 with a series of glide bombs known as Gargoyles. In 1945, it built the sleek Katydid missile and, in 1949, the Kingfisher antiship missile. The fourth McDonnell air-launched missile was the Quail (Air Force designation GAM-72) in 1958. These refrigerator-sized missiles were carried by B-52s and launched to confuse radar and divert enemy fire from the target-bound bombers. McDonnell also built airframes and

integrated ramjet engines for the Navy's Talos surface-to-air missile.

McDonnell missile experiments included the Alpha Draco in 1959, for weight and speed, and the 1963 ASSET reentry research vehicle, which tested advanced metals and materials in hypersonic flights up to 18 times the speed of sound.

On Jan. 12, 1959, NASA selected McDonnell to build America's first crewed spacecraft, for Project Mercury. The goal was to place a human in orbital flight around the Earth, investigate human abilities to function in the environment of space, and recover the human and the spacecraft safely.

On May 5, 1961, astronaut Alan Shepard, aboard a McDonnell Mercury capsule, became the first American to go into space. On Feb. 20, 1962, John Glenn, also aboard a Mercury, became the first American to orbit Earth.

McDonnell then built the two-person Gemini spacecraft for 10 crewed missions between March 23, 1965, and Nov. 11, 1966. Gemini allowed astronauts to practice techniques for operating outside the space vehicle, docking, and rendezvous.

By 1966, McDonnell was the largest employer in Missouri, was firmly established as an aircraft production giant, and was in the best position to respond to the Douglas Aircraft Company's invitation to consider a merger.

For some time, McDonnell had wanted to enter the field of commercial aviation. He had talked about merging with Douglas since 1963 and had even offered to build the DC-9 jointly with Douglas.

In late 1966, Douglas, recognized around the world for its DC series of propeller-powered commercial airliners, reported that, despite its backlog of orders, startup and production costs for jet-powered airliners were straining company resources and costs of training new people and tooling up were unpredictably high.

In December 1966, the Douglas board of directors sent out bid invitations for possible merger prospects. North American Aviation was also among



1954

Skyhawk  
Model 357-80  
Ordnance  
F-101  
Voodoo

Navaho missile  
C-133  
Cargomaster  
Russia launches Sputnik

Model 707  
Thor missile  
Phantom  
F-2 DC-8  
Buckeye

ASJA-5  
Vigilante  
F-4  
Phantom  
T-2 DC-8  
Buckeye

Model 720  
Hound Dog  
missile  
Boeing par/haines Vertol

Mercury space capsule  
first crewed flight  
Delta  
launch vehicle  
Boeing par/haines Vertol

Model 720  
Hound Dog  
missile  
Boeing par/haines Vertol

Mercury space capsule  
first crewed flight  
Delta  
launch vehicle  
Boeing par/haines Vertol

Model 720  
Hound Dog  
missile  
Boeing par/haines Vertol

Model 727  
OH-6  
Caspian  
helicopter

Model 727  
OH-6  
Caspian  
helicopter

Model 727  
OH-6  
Caspian  
helicopter

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Model 727  
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Caspian  
helicopter

1966

Model 727  
OH-6  
Caspian  
helicopter

Model 727  
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helicopter

Model 727  
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Caspian  
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Model 727  
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Caspian  
helicopter

1972

Model 727  
OH-6  
Caspian  
helicopter

Model 727  
OH-6  
Caspian  
helicopter

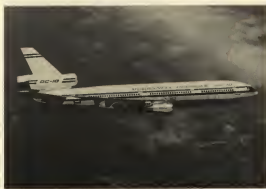
Model 727  
OH-6  
Caspian  
helicopter

Model 727  
OH-6  
Caspian  
helicopter

companies wanting to join forces with Douglas and was a sentimental favorite, since it was already based in Southern California. However, McDonnell submitted the winning bid.

The McDonnell Douglas merger was official April 28, 1967. James Smith McDonnell, then 68, was chairman of the board of directors and chief executive officer of the new McDonnell Douglas Corp. Donald Douglas Sr. was honorary chairman of the merged corporation. Donald Douglas Jr., 46, continued as president of the Douglas component for a year, when he became corporate vice president of administration.

The merger of McDonnell and Douglas allowed each company to profit from its successful specialties. Douglas, in commercial transports, within a year of



the merger, launched the widebodied DC-10, which made its first flight on Aug. 29, 1970. It was later adapted as the KC-10 aerial refueling tanker for the Air Force.

On Oct. 18, 1979, the DC-9-80 Super 80 made its first flight. With a

modified wing, new engines, and a longer fuselage than the previous DC-9s, it was redesignated the MD-80 and became the cornerstone for a new series of jetliners.

The new McDonnell Douglas Corp. continued as a leader in space technology. It converted one of the Saturn V third-stage (S-IVB) rockets into Skylab, which was placed into orbit May 14, 1973. The rocket's hydrogen tank was converted into a spacious two-story dwelling for a three-person crew, with sleeping quarters and storage areas for food, water, and other supplies.

Last occupied in 1974, it reentered Earth's atmosphere and burned up on July 11, 1979. Three crews stayed aboard Skylab, providing invaluable information about how people are affected by long periods in space and about comets, the cosmos, and solar flares.

#### NORTH AMERICAN ROCKWELL CORP.

*"We set sail on this new sea because there is new knowledge to be gained, and new rights to be won, and they must be won and used for the progress of all people. For space science, like nuclear science and all technology, has no conscience of its own. Whether it will become a force for good or ill depends on man."*

—President John F. Kennedy, Rice University Stadium, Houston, Texas, Sept. 12, 1962

North American began four advanced aeronautical projects in 1954: a Mach 2 version of the Sabre Jet, a Navy weapon system called North American General Purpose Attack Weapon (NAGPAW), a superbomber, and a rocket research airplane.

The F-100 Super Sabre, which first flew on May 25, 1953, was the world's first production aircraft capable of flying faster than the speed of sound in level flight (760 mph). It was the first of the Air Force "century series" aircraft, and more than 2,290 F-100s were built before production ended in 1959.



The improved F-107A Super Sabre first flew Sept. 10, 1956. During its initial flight, the F-107A reached Mach 1.03 and, on Nov. 3, 1956, it reached Mach 2. Three F-107As were built and used for testing and research, but the airplane did not go into production.

The NAGPAW concept evolved into the two-place, twin-engine shipboard attack aircraft A-5 Vigilante built for the U.S. Navy. It was flown for the first time in August 1958.

The superbomber was the XB-70A Valkyrie, an experimental high-speed, delta-wing aircraft designed to fly at three times the speed of sound and at altitudes higher than 70,000 feet. The large B-70 had a startlingly beautiful form with a siletto-shaped fuselage. Its airframe was constructed out of welded stainless steel honeycomb. It used the newly discovered "compression lift," lift from shockwaves created in supersonic flight. The Valkyrie achieved Mach 3 on Oct. 14, 1965.

1954

Skyhawk  
Model 367-80  
Quail 80  
F-101  
Voodoo

KC-135  
C-133  
CargoMASTER  
Russia launches Sputnik

Model 707  
Thor missile  
F-4 Phantom II  
F-2, DC-8  
Buckeye

ASJA-5  
Vigilantes  
GM-77  
Hound Dog  
missile

Model 720  
Ogta  
lunch vehicle  
Chinook  
helicopter

Mercury space capsule  
first crewed flight  
Minuteman  
missile  
Boeing purchases Vertol

1966

▲ Vietnam War  
Model 727  
OH-4  
Coyote  
helicopter

DC-9  
OH-10  
Boeing  
Gemini spacecraft

Lunar Orbiter  
Saturn V launch

1972

▲ Apollo spacecraft  
takes first humans  
to land on the moon

The rocket research plane was the X-15, which provided valuable data about how pilots react at high speeds under extreme conditions. It was an early test platform for human-in-space programs to follow. Several X-15 pilots earned "astronaut" wings by flying above an altitude of 50 miles at 4,000 mph. The X-15 program ran concurrently with Mercury, Gemini, and Apollo programs and was extremely valuable in developing space environmental and attitude-control systems as well as reentry profiles.

These new airplanes would be flying into the thermodynamic barrier, where frictional heat on their surfaces would be too severe for common aircraft metals. A completely new technology of aircraft systems and structures was necessary for surviving the hypersonic flight environment.

NAA's Rocketdyne Division developed the booster main propulsion system for the Navaho intercontinental missile and, although that program was discontinued, its technology was incorporated into propulsion systems for space launch vehicles like Thor, Redstone, and Jupiter.



NAA Rocketdyne projects included the massive 1.5-million-pound-thrust F-1 engine for the Apollo-Saturn and Skylab programs, propulsion systems for Earth-orbit Apollo development and the Apollo-Soyuz missions, plus small engines for attitude and reaction control for the Gemini and Apollo command spacecraft. Eight NAA Rocketdyne H-1 engines launched Saturn and Saturn IB; the

NAA Redstone propulsion system sent a chimpanzee into successful Earth orbit.

Closer to earth, NAA Rocketdyne developed a prepackaged storable-propellant propulsion system for the Army's battlefield Lance missile.

NAA's Autonetics division adapted the Navaho's navigation unit for use on the Nautilus submarine; the system helped the vessel make the first under-ice passage of the North Pole in 1958.

In 1960, NAA Missile Development Division was awarded a \$4 million contract to develop, fabricate, and flight test the Redhead/Roadrunner, a Mach 2 high- and low-level target missile. The Rocketdyne division provided the solid rocket motor for the Roadrunner.

At the same time, the company maintained brisk production of its well-established product lines. In the forefront as a trainer manufacturer, NAA started its first jet-powered trainer, the XT2J-1, in 1956 as a multitask aircraft for the Marine Corps. The subsequent T-2 Buckeye trainer, built at the Columbus, Ohio, plant, took its



name from the state's nickname and was the first jet trainer designed to take students from primary through advanced training in a single airplane.

During the Vietnam War, NAA developed the OV-10 Bronco as a twin-turboprop short-takeoff-and-landing (STOL) aircraft. Developed under an Air Force, Navy, and Marine Corps triservice program, it was the first aircraft designed and produced especially for close support operations in limited warfare. Used as a light armed-reconnaissance aircraft, the Bronco first flew July 16, 1965, and the production version first flew Aug. 6, 1967. It continued to operate for countries other than the United States through 1998.

NAA first produced the Air Force T-39 (NA-285) Sabreliner in 1958 as a utility aircraft and VIP aircraft that could also be used as a trainer, and more than 600 Sabreliners entered service, 212 as military T-39s. In 1965, the Sabreliner was the first jet aircraft to be equipped with automatic terrain-following capability.

The company continued to study aerospace atomic propulsion and ways to generate nuclear power for civilian use. NAA's Atomics International Division in 1957 showcased its Sodium Reactor Experiment (SRE) and, by the early 1960s, the company had installed more than a dozen research and utility

1954

■ Skyhawk  
Model 367-90  
Dorn 90  
■ F-111  
Woodoo

■ KC-135  
Navaho missile  
C-133  
Cargomaster  
Hasele launches Spuik  
■ T-2 DC-8  
Buckeye

Model 707  
■ ASMA-5  
Vigilante  
■ Thor  
missile  
■ F-4  
Phantom  
■ T-2 DC-8  
Buckeye

1960

Model 720  
■ GQM-77  
Hour Dog  
missile  
■ Delta  
launch vehicle  
Boeing outpaces Vertol

Mercury space capsule  
first crewed flight  
■ Minuteman  
missile  
■ CH-47  
Chinook  
helicopter

1966

▲ Vietnam War  
Model 727  
■ OH-6  
Cayuse  
helicopter

■ DC-9  
■ OV-10  
Bronco  
■ Gemini spacecraft

Lunar Orbiter  
Saturn V launch

1972

▲ Apollo spacecraft  
takes first humans  
to land on the moon

reactors in the United States and in foreign countries. It had two European affiliates, Dynatron in France and Interatom in West Germany.

In 1960, Kindelberger stepped down as company CEO and handed the reins to Lee Atwood, who had been with him since they worked together at the Douglas Aircraft Company, and who had been company president since 1948.

Kindelberger remained chairman of the board until his death two years later. Atwood then took over as chairman and remained a member of the board of directors and senior consultant to North American until 1978.

NAA won the contract to develop the Apollo spacecraft system Nov. 28, 1961. By the final Apollo flight, North American had begun work on the Space Shuttle, the world's first reusable spacecraft. It built six Space Shuttles between



1972 and 1991, as well as their three main engines.

North American's path to the moon went across the continent from Downey on the West Coast to the launch site in Florida. Throughout the nation, North American coordinated services from more than 20,000 firms and research activities at hundreds of universities and scientific laboratories.

By the mid-1960s, because of its commitment to Apollo and other space programs, North American Aviation was heavily dependent on business from the government, and it needed to expand its product lines

to minimize the loss of revenue once these programs were discontinued.

Although North American management was cautious about entering nonmilitary territory, since the company's only money-losing venture had been

a venture into commercial aircraft, the Navion, company directors continued to look for a corporate partner.

At one point in 1967, it looked as if North American would join the Douglas Aircraft Company, but Douglas selected the McDonnell Aircraft Corp. for that merger.

So, in September 1967, North American combined operations with Rockwell Standard. This relationship had its start the previous year when Lee Atwood, NAA president, met Willard F. Rockwell Jr., president of Rockwell Standard Corp., on a *Time* magazine-sponsored tour of Europe and the Soviet Union.

Rockwell and North American had each made a profit of \$50 million the previous year. Rockwell Standard was the world's largest producer of automobile parts, particularly equipment for heavy trucks. It also was a leading producer of gears, steel shafts, cotton gins, and other industrial items.

The merger with Rockwell allowed North American to diversify its activities into the commercial and industrial sector while maintaining its position as a preeminent government contractor. The new company combined the talents of 110,000 people in more than 100 plants and established a network of international operations with 34 manufacturing affiliates, subsidiaries, and principal licensees in 17 countries.

North American Aviation division became the Aerospace and Systems Group. The Rockwell Standard divisions became the Commercial Products Group. The new company was called North American Rockwell Corp. Its new advertisements on national television promoted North American's air and space products and Rockwell's high-fashion fabrics and heavy equipment.

1954

Skyhawk  
Model 967-80  
Oash 80  
F-101  
Voodoo

KC-135  
Navaho missile  
C-133  
Cargomaster  
Russia launches Sputnik

Model 707  
Thor missile  
Buckeye

A3J/A-5  
F-4 Phantom  
T-2 D-C-8

Model 727  
GAM-77  
Hound Dog missile  
Boeing purchases Vertol

Mercury space capsule  
first crewed flight  
Minuteman  
Delta launch vehicle  
Chinook helicopter

1960

1966

▲ Vietnam War

Model 727  
OH-6  
Cayuse helicopter

DC-9  
OH-10  
Bronco

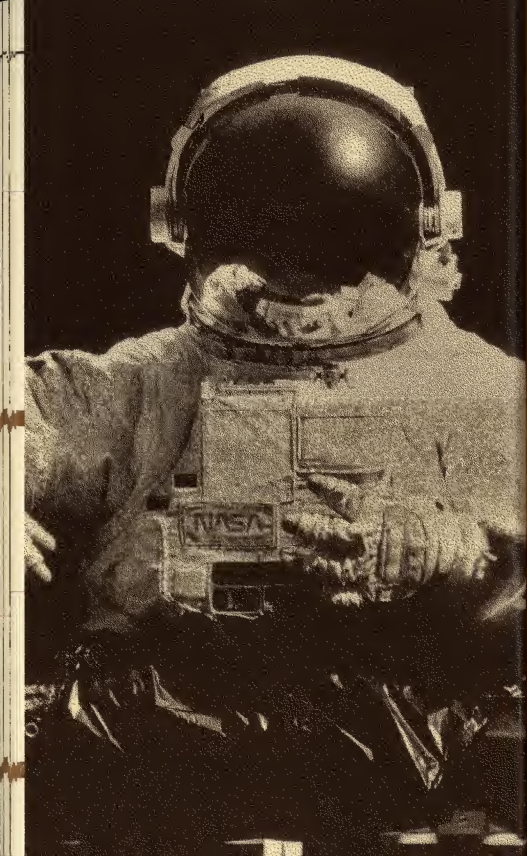
Lunar Orbiter  
Saturn V launch

German spacecraft

1972

▲ Apollo spacecraft  
takes first humans  
to land on the moon





*At the  
crossroads*

*1967-1997*

**THE BOEING COMPANY**

*"Now and in years to come, Boeing will maintain its leadership position in commercial jet transports, win more military and space business, and advance our computer and electronic divisions."*

—Frank Shrontz

As the 1970s began, a number of factors came together to push Boeing into a crisis. The big Apollo project wound down, and the company hoped to make up for the decrease in space-related business by increasing sales of commercial aircraft.

Unfortunately, rising fuel costs and loss of passenger revenue caused a recession in the aviation industry. In addition, the massive Boeing jet, the 747, had not yet established itself in the market and had unexpectedly high startup costs and initial delivery problems. Boeing went 18 months without a single new domestic order for the 747.

The end of the Supersonic Transport (SST) program dealt another blow. Aided by federal funds, Boeing had made major progress, but Congress “pulled the plug” on SST funding in March 1971, forcing Boeing to cancel the program.

Between early 1970 and October 1971, the Boeing workforce was cut from 107,962 to 61,826. Thousands of former Boeing employees, finding little in the local job market, looked for work elsewhere. Things became so bad in Seattle that a billboard on the city's outskirts read, "Will the last person leaving Seattle turn out the lights?"

Dealing with the new challenges was Thornton "T" Wilson, who became the company president in 1968. When Wilson became chairman of the board in 1972, Malcolm Stamper was named president, holding that position until 1985.

To attract new business, Boeing expanded its territory beyond aviation. Boeing Computer Services sold commercial computer products, including one used by 148 government and commercial customers, and staffed computer training centers around the country.

Boeing employees irrigated an eastern Oregon desert, managed housing

projects for the Federal Department of Housing and Urban Development, built a desalinization plant that converted sea water to fresh water for a resort in the Virgin Islands, and built voice scramblers for police departments. They produced light-rail vehicles for Boston and San Francisco; introduced personal rapid transit (PRT) in Morgantown, W.Va.; and built three gigantic wind turbines in the Columbia River gorge.

Boeing continued to promote sales of its commercial airplanes and worked on several key defense and space programs. In 1974, the Boeing *Mariner 10* probe was launched from the Kennedy Space Center on a course for Venus and Mercury. The same year, the E-4, the Advanced Airborne Command Post, using the 747 airframe, made its first flight.

By then, Boeing had produced its 1,000th short-range attack missile (SRAM) and started on 1,715 air-launched cruise missiles (ALCM). In 1976, the first Airborne Warning and Control System (AWACS), using the 707 airframe, first flew.

By 1983, the recession began to ease off, and the 1,000th 737 rolled out from the Renton plant. Boeing teamed up with other companies on new military projects, including the B-1B bomber with Rockwell International (formerly North American Rockwell), the B-2 bomber with Northrop, the V-22 Osprey tiltrotor with Bell Helicopter Textron, the F-22 fighter with Lockheed and General Dynamics, and the Comanche armed reconnaissance helicopter with Sikorsky.

The company also produced advanced composite wings for Navy A-6 fighters and built the mobile Avenger and the European-designed Roland surface-to-air missile systems. At the same time, it continued to improve and

Boeing commercial airliners and their military versions were once again mainstays of civilian airlines and defense systems. Jetliners had to be faster,





757, the larger 767, and upgraded versions of the 737.

In 1990, Boeing jets carried more people than lived in Earth's 100 largest cities – 675 million, the equivalent of 12 percent of the world's population. In 1993, Boeing launched the Next-Generation 737-600, -700, -800, and -900. On April 9, 1994, the Boeing 777 rolled out. The 777 was the largest twinjet in the world.

Frank Shrontz became president of The Boeing Company in 1985, chief executive officer in 1986, and board chairman in 1988.

In 1991, Boeing celebrated its 75th anniversary and planned for its future in an increasingly competitive worldwide market. Phil Condit, president of The Boeing Company and member of the board of directors since 1992, assumed the duties of chief executive officer in April 1996.

#### MCDONNELL DOUGLAS CORP.

*"Our work is part of a great team effort. I congratulate all of you who have worked so long and hard. This is old Mac signing off."*

—James S. McDonnell

The McDonnell Douglas merger in 1967 kept both companies largely in aerospace, and their combined operations were now the second largest in the country, just behind Boeing. And, like Boeing, the end of the Apollo-Saturn era and the nationwide recession in the aircraft industry sent McDonnell Douglas scrambling for product alternatives.

Commercial airlines, affected by more rising fuel costs and a decrease in the number of passengers, placed their airplane orders on hold. Employment at McDonnell Douglas dropped to 62,830. The McDonnell Douglas West corporate office at Santa Monica was closed, and the Santa Monica factory was demolished.

quieter, and more energy efficient because while fuel prices had gone up, so had the number of airports, passenger flights, and environmental concerns. To meet these challenges, Boeing produced the standard-body

New products included the Air Combat Maneuvering Simulator (ACMS) and the Manned Air Combat Simulators (MACS) for training fighter pilots and hardware for military aircraft.

McDonnell Douglas also dabbled in truck leasing and sold computer services through McAuto, a wholly owned subsidiary of the company, selling hardware and software. The company's VITEK subsidiary developed systems for the medical industry. Another subsidiary, Coaliquid, examined alternatives to fuel oil. Other subsidiaries explored solar energy and sold microwave vacuum drying systems.

Before the 1967 merger, McDonnell had explored vertical-takeoff-and-landing (VTOL) aircraft with the Air Force Experimental XV-1 convertiplane that made its first in-flight conversion from helicopter to propeller-powered craft in April 1954 and was the first rotorcraft to fly more than 200 mph. During the 1960s, the company also produced the Model 120, a ship-to-shore VTOL flying crane for the Marine Corps, and the Model 188, a turboprop short-takeoff-and-landing (STOL) transport; both were too expensive to be successful.

In 1969, McDonnell Douglas partnered with British Aerospace and the Marine Corps to begin work on the AV-8B Harrier II, based on the original Hawker Siddeley British Royal Air Force Harrier. This unique V/STOL "jump jet" proved itself as a ground-support attack aircraft. It evolved into the radar-equipped AV-8B Harrier II Plus, which made its first flight in 1992.

Since the mid-1960s, aircraft manufacturers around the country were studying ways to build an advanced tactical fighter that could engage in all types of aerial combat at minimum weight and cost. In 1967, McDonnell Douglas engineers started work on a fighter to follow the Phantom II. This was the F-15 Eagle, which first flew July 27, 1972, and entered service in 1974. The Eagle would shatter many existing records and fly with air forces in Israel, Japan, and Saudi Arabia.

What distinguished the Eagle from all other aircraft of the time was the power of its two engines: their thrust was greater than the weight of the fully loaded plane. It could climb straight up, accelerating to supersonic speed.

In 1975, the Navy named McDonnell Douglas as prime contractor of the F/A-18 Hornet, a multirole fighter design for aircraft carrier duty.

1967

▲ Misses 737-100  
▲ McDonnell and Douglas merge  
into McDonnell Douglas Corp.  
Model 747-100  
▲ North American Aviation, Inc., merges  
with Rockwell Standard Corp. into  
North American Rockwell Corp.  
Model 747-100  
▲ North American Rockwell is  
renamed Rockwell International

1978

Space Shuttle  
Harrier  
Model 767  
rockets boosters  
Model 757

1989

T-45  
Goldenrod  
Pumpkin Gulf conflict  
F-22  
MD-11  
C-17  
Gloemaster II  
Model 777  
MD-90  
International  
Space Station

2000

▲ McDonnell Douglas Corp.  
merges with Boeing  
RAH-66 Comanche  
▲ Rockwell International Corp.  
merges with Boeing





## ROCKWELL INTERNATIONAL CORP.

*"Some things have not changed, and should not change, and I trust will not change. We have certain principles and traditions. The company was conceived and founded on a basis of responsibility that when we work for the government, our responsibility is exceptional — a responsibility of stewardship of public money on one hand, and a responsibility for valuable equipment on the other."*

—Lee Atwood

The merger of North American Aviation and Rockwell Standard Corp. provided increased opportunities for new products, so North American was ready to deal with the recession by diversification. By 1971, the company was researching wastewater management for the Envirotech Corp. and developing technologies for small engines and new rocket propellants.

In 1973, North American Rockwell renamed itself Rockwell International to reflect its expanding business. The Apollo program and, in 1973, the milestone launch of Pioneer II established Rockwell International's Rocketdyne division as the country's foremost producer of liquid-fueled rocket engines.

Rocketdyne had built 8,920 large liquid-propellant engines. In addition to the Saturn propulsion systems, its projects included engines for the Space Shuttle and propulsion systems for *Mariner 9* and the Army's Lance missile. It went on to provide Peacekeeper missile Stage IV responsibilities as well as engines for Boeing JETFOILS and Delta and Atlas launch rockets.

The company's division of Atomics International began work on the Clinch River Plant, the country's first large-scale demonstrator breeder nuclear electric power plant. Atomics International also developed small Systems for Nuclear Auxiliary Power (SNAP) generators that would be used in NASA's deep space probes, such as the Viking Mars Lander.

Autonetics, established as part of North American Rockwell's Electronics Group in 1972, pioneered microelectronic systems and subsystems for United States defense, including inertial navigation equipment for Minuteman and Peacekeeper ICBMs, as well as radar and data processing equipment like the Ships Inertial Navigation System (SINS). Other projects included flight

controls, autonavigators, displays, automatic checkout equipment, and other electromechanical devices for a variety of weapons.

In December 1980, the division became part of Defense Electronics Operations. Its programs included the Hellfire antiarmor missile system, GBU-15 Guided Weapon system, Airborne Laser Tracker, Maverick Missile Seeker, and spot tracker for the AH-64 Apache helicopter.

The aircraft division of Rockwell International became the North American Aircraft division working on the B-1 bomber. The first of four B-1 prototypes flew on Dec. 23, 1974, but the government canceled the program three years later.

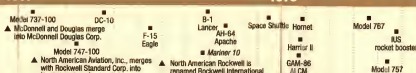
The next bomber built by North American was the B-1B, for which Boeing supplied the avionics. It looked like the B-1A, but it had a different mission. The B-1A was designed to penetrate enemy defenses to drop its bombload. The B-1B was a cruise missile carrier, able to launch its missiles a great distance from the target. Although its mission was primarily low-level penetration at high subsonic speeds, the B-1B could fly at supersonic speeds. The B-1B first flew on Oct. 18, 1984, about five months ahead of schedule.

In 1984, the company's divisions of Rocketdyne, Atomics International, and the Engineering Technology Engineering Center merged into the North American Space Division and the Satellite Division. The focus continued to be aircraft modifications, aerostuctures, and advanced aircraft, including the Lockheed AC-130U Gunship, which completed 164.5 hours of test flight at Edwards Air Force Base by the end of 1991.

North American and Deutsche Aerospace also collaborated on the design and construction of the X-31 Enhanced Fighter Maneuverability demonstrator. This was the first international experimental aircraft development program administered by a U.S. government agency. The X-31 first flew on Oct. 11, 1990.



1967



1978

1989



2000

A black and white photograph of a large, modern building with a curved facade. The word "BOEING" is prominently displayed in large, stylized letters at the top. Below the name is a series of tall, narrow windows separated by thick vertical columns. The building is set against a clear sky, and some foliage is visible in the foreground.

BOEING

*The giants  
merge*

*1997*

*"Essential to our success is our detailed customer knowledge, large-scale, complex system integration, and lean efficient design and production systems."*

—Phil Condit

In December 1996, Boeing merged with Rockwell International Corp.'s aerospace and defense units, uniting the two companies. Rockwell's space systems, aircraft division, Rocketdyne, Autonetics, missile systems, and aircraft modification were renamed Boeing North American, Inc., and operated as a Boeing subsidiary.

North American employees continued to chart new territory, using the commitment to visions and goals established by Dutch Kindelberger and Lee Atwood, which were now meshed with the vision of The Boeing Company as a global enterprise, with significant geographical spread in its operations.

On Aug. 1, 1997, Boeing, with its North American component, merged with McDonnell Douglas Corp. Philip M. Condit remained as chief executive officer and chairman of the new Boeing board of directors. Harry C. Stonecipher, formerly McDonnell Douglas president and chief executive officer, became president and chief operating officer.

In June 1998, Boeing was the world's largest manufacturer of commercial jetliners and military aircraft and was the nation's largest NASA contractor.

The company had an extensive global reach with customers in 145 countries, employees in more than 60 countries, and operations in 27 states. Worldwide, Boeing and its subsidiaries employed more than 234,000 people – with major operations in the Seattle-Puget Sound area of Washington state; Southern California; Wichita, Kan.; and St. Louis, Mo.

The main commercial products consisted of the 717 (formerly the MD-95), 737, 747, 757, 767, and 777 families of jetliners as well as the MD-11, MD-80, and MD-90. In total, the company had more than 9,000 commercial jetliners in service worldwide

By 1998, the company was responsible for a substantial number of military aircraft and defense-system products and programs. These included the C-17 Globemaster III, the Airborne Laser, the F/A-18 Hornet and Super Hornet, the F-15 Eagle, and the AV-8B Harrier. Other military aircraft included the T-45 Goshawk, the 767 AWACS, the RAH-66 Comanche, the CH-47 Chinook, the AH-64 Apache Longbow, and the V-22 Osprey. Defense systems included

the Harpoon antiship missile, the Standoff Land Attack Missile Expanded Response (SLAM ER), and the Joint Direct Attack Munition (JDAM).

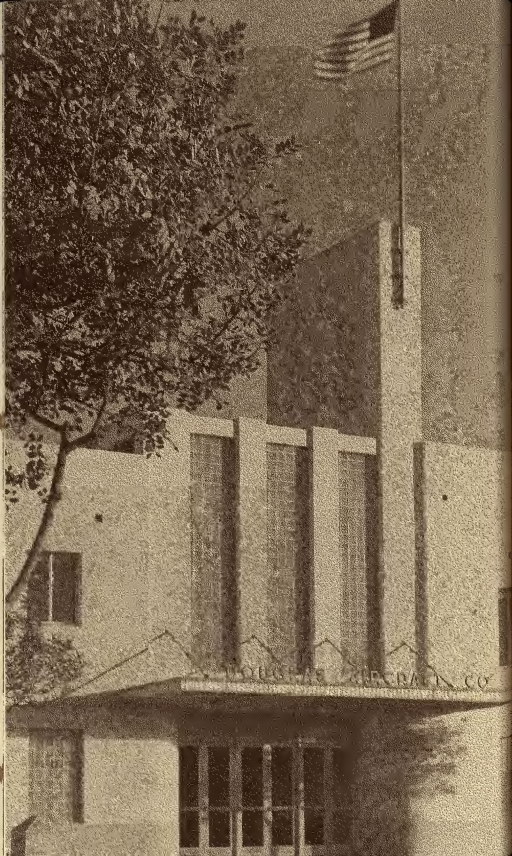
As NASA's leading contractor, the company's future was linked to space flight and exploration and to increasing commercial applications in space. Boeing led the U.S. industry team for the International Space Station, built the Space Shuttle orbiters and their main engines, prepared the Shuttle's payloads, and integrated the overall Shuttle system.

In the area of commercial space, Boeing teamed with Teledesic Corp. to begin development of a satellite network to serve as an “Internet-in-the-sky,” revolutionized precision navigation by building the first 40 Global Positioning System (GPS) satellites, and was awarded a contract to build 33 next-generation GPS satellites. In addition to building Delta expendable launch vehicles, Boeing was teamed with partners from Russia, Ukraine, and Norway on the Sea Launch joint venture. Boeing also began leading a team defining the National Missile Defense program.

The aviation giants that had evolved from the Boeing, Douglas, McDonnell, and North American enterprises were now working as one, building the future of flight on Earth and beyond it.

*Major Boeing Facilities and Employment by Region in 1998*





# *Biographies*



William Edward Boeing was born in Detroit, Mich., on Oct. 1, 1881. His father, a German immigrant, began as a timber merchant, but after iron and gold were discovered, became owner of one of the largest iron mines in the Mesabi Iron Range, in the heart of Minnesota's Arrowhead County. Boeing's father died when William was only eight years old, but his Viennese mother, Marie, instilled in her son a love of perfection and a sound business sense. William was sent to school in Europe for a few years and then attended Yale University.

Boeing left Yale when he was 22 years old. He headed West to follow in his father's footsteps and enter the risky and cyclical timber business. He made a small fortune and moved to Seattle in 1908. There he became intrigued with flying, formed a club for aviation enthusiasts, and started the Boeing Airplane Company. In 1922, at the age of 41, he married Bertha Potter, who would later christen two of the company's greatest achievements – the first Boeing mail and passenger plane and the first Boeing jet transport.

By 1929, Boeing's business interests grew from a small West Coast aircraft manufacturing company to the huge United Aircraft and Transport Corp. of aircraft, engine, and propeller manufacturers as well several airlines. New Deal legislation, in 1934, mandated that Boeing break up his holdings.

Boeing sold his interests in the company. He founded and focused on other business pursuits, becoming one of America's most successful breeders of thoroughbred horses. He and his family spent many summers cruising the Pacific Coast to Alaska aboard their 125-foot luxury yacht, the *Taconite*, named after a mineral common in iron mines.

Boeing never lost his interest in aviation and, during World War II, volunteered as a consultant to the company. He died aboard the *Taconite* Sept. 28, 1956.



Donald Wills Douglas, the second son of an assistant cashier of the National Park Bank, was born in Brooklyn, N.Y., on April 6, 1892, and started his education at Trinity Chapel School in New York City.

In 1909, at the age of 17, Donald Douglas entered the U.S. Naval Academy at Annapolis, where he spent much of his time building and testing model airplanes. Douglas' family, fellow midshipmen, and professors thought his interest in aviation was an infatuation that would pass and were very surprised when he left the Naval Academy in 1912, before he graduated, to look for work in aeronautical engineering.

Douglas completed the four-year bachelor of science program in mechanical engineering at the Massachusetts Institute of Technology (MIT) in only two years. And, because of his academic performance, Douglas was immediately hired by MIT as an assistant professor in aeronautics.

In 1915, Douglas became a consultant to the Connecticut Aircraft Company to help build the first Navy dirigible. In August of the same year, he joined the Glenn L. Martin Company, then situated in Los Angeles. In 1916, he served briefly as chief civilian aeronautical engineer for the Army Signal Corps Aviation Section in Washington, D.C., and married Charlotte Marguerite Ott in Riverside, Calif. He took her back to Cleveland, Ohio, where Martin had relocated.

In 1920, Douglas and his family were back in California, where he founded the Douglas Aircraft Company. By 1940, Douglas Aircraft had made \$60,970,774 selling commercial transports and their military derivatives. Douglas products continued to remain on the leading edge of the industry and included missiles and space products as well as popular jet transports.

Donald Wills Douglas Sr. was company president until 1957, when his son, Donald Douglas Jr., took over that position. Donald Douglas Sr. remained chairman of the Douglas Aircraft Company board until its merger with the McDonnell Corp. Then, at the age of 75, on April 28, 1967, Donald Wills Douglas Sr. retired. He remained honorary chairman of the McDonnell Douglas board until his death on Feb. 1, 1981.

He lived for almost a century and had presided over the birth, the growth, and the evolution of the aerospace industry.



James Smith McDonnell was born in Denver, Colo., on April 9, 1899. He grew up in Little Rock, Ark., where his father, also called James McDonnell, was a successful cotton merchant.

Every morning before school, young James S. McDonnell delivered copies of the *Arkansas Gazette* on horseback. He graduated from Little Rock High School in 1917, just as World War I broke out. McDonnell served briefly as a private in the Army. McDonnell then attended Princeton University, from which he graduated, in 1921, with honors in physics. While in college, he joined the Reserve Officers Training Corps (ROTC). After Princeton, he enrolled at MIT for graduate studies in aeronautical engineering. While still at MIT, he continued his ROTC affiliation, passed the Army Air Service physical, and passed much of the ground school work required for pilots. In August 1923, McDonnell was commissioned as a second lieutenant in the Army Air Service Reserve and assigned to Brooks Field, Texas, for flight training. He graduated from MIT in 1925.

After earning his pilot's wings, McDonnell spent a year as a "gypsy pilot," doing odd jobs for people who owned airplanes.

Finally, he landed a job as aeronautical engineer and pilot with Huff Daland Airplane Company in Ogdensburg, N.Y. In 1928, McDonnell started his first company to build the single Doodlebug, but since it found no market, he spent the next 10 years working for several aircraft companies, finally as a chief engineer with the Glenn L. Martin Aircraft Company.

On June 30, 1934, he married Mary Elizabeth Finney, whose father, Dr. John Finney, was founder of the American College of Surgeons.

McDonnell resigned from Martin in 1938, determined to form his own company. On July 6, 1939, he incorporated the McDonnell Aircraft Corp. in St. Louis, Mo.

Within the next three decades, the company would become the leading producer of jet fighters and would build the first spacecraft to carry an American into orbit.

After the 1967 merger with the Douglas Aircraft Company, James McDonnell took over the positions of chairman and chief executive officer, which he held until 1972. He served as chairman of the board of directors of the McDonnell Douglas Corp. until his death Aug. 22, 1980.



James Howard "Dutch" Kindelberger was born in Wheeling, W.V., on May 8, 1895, the son of steelworker Charles Frederick Kindelberger. Kindelberger started working in the steel industry with his father but, in 1916, when he was 21 years old, went to study at the Carnegie Institute of Technology.

The United States entered World War I in 1917, and Dutch Kindelberger joined the Army to serve in the Aviation Section of the Signal Corps. He was a pilot instructor based at Park Field in Memphis, Tenn.

After the war, Kindelberger looked for work in aviation. In 1919, he married Thelma Knarr and, in 1920, became chief draftsman and assistant chief engineer with the Glenn L. Martin Aircraft Company in Cleveland. Five years later, he joined Douglas Aircraft in California as chief engineer. Kindelberger remained with Douglas for nine years, leading development of the DC-1 and the DC-2.

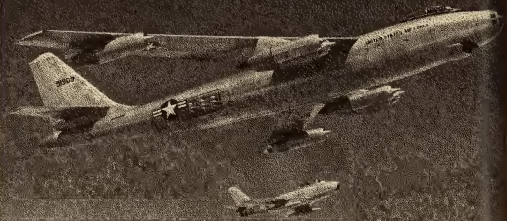
In 1934, Kindelberger became president and general manager of General Aviation, later renamed North American Aviation, Inc., and served as general manager until 1948, when he became chairman and chief executive officer. Under his guidance, North American Aviation broke technological barriers; produced propeller- and jet-powered fighters and bombers, military trainers, rocket engines, and rocket-powered aircraft; and began its role as the prime contractor for the country's space program.

Kindelberger retired in 1960 as chief executive officer at the age of 65 and was succeeded by Lee Atwood. Kindelberger remained chairman of the board until his death two years later.



*J. H. Kindelberger*





*Gallery  
of products*

**B & W • MODEL 1 • UTILITY SEAPLANE • FIRST FLIGHT: JUNE 15, 1916**

The B & W was the first Boeing product, named after the initials of its designers, William Boeing and Conrad Westervelt. The twin-float seaplane had a 52-foot wingspan and was 27.5 feet long. It was powered by a 125-horsepower Hall-Scott A-5 engine and could cruise at 67 mph. The two B & Ws were sold to New Zealand for pilot training, and one made that country's first official airmail flight on Dec. 16, 1919.

**Model C • MODELS 2, 3, AND 5 • NAVY TRAINER • FIRST FLIGHT: NOV. 15, 1916**

The C-series two-place trainer had a 43-foot 10-inch wingspan and was 27 feet long. It was powered by a 100-horsepower Hall-Scott A-7A engine and could cruise at 65 mph. Boeing built 56 Model Cs. Fifty-one of the Model Cs were built for the Navy, one of which was modified with a single pontoon and designated the C-1F. Two were redesigned with landing gear for the Army and designated the EA. Boeing used the C-700 to demonstrate possibilities of airmail.

**DH-4 • MODEL 16 • DE HAVILLAND DESIGN OBSERVATION/BOMBER/TRAINER • FIRST DELIVERY: MARCH 6, 1920**

Boeing switched the position of the pilot's cockpit and the airplane's fuel tank to make the British-built de Havilland 4 Liberty planes more fireproof. From 1923 to 1925, Boeing rebuilt 186 of the biplanes using its own "arc welding" process for the steel-tube fuselage. This process was crucial to later development of the first Boeing fighters. DH-4s were also rebuilt by the American Fokker company, which was acquired by North American Aviation in 1923.

**The Cloudster • FACTORY SERIAL NUMBER 100 • PASSENGER BIPLANE • FIRST FLIGHT: FEB. 24, 1921**

The Cloudster was the first Douglas product. It had a 56-foot wingspan, was 36 feet 9 inches long, and was powered by a 400-horsepower Liberty engine. It could fly at 120 mph. On March 19, 1921, it climbed to 19,160 feet and broke the Pacific Coast altitude record. It was the first U.S. aircraft that could carry a useful load exceeding its own weight.

**DT-1 and -2 • BOMBER • FIRST FLIGHT: NOVEMBER 1921**

Douglas built 41 DT torpedo bombers, while other companies built 55. These folding-wing aircraft had a 50-foot wingspan and could fly at 101 mph. They had a welded-steel fuselage, with aluminum covering on the forward and center sections and fabric on the rear section. A single 1,800-pound torpedo could be mounted under the plane's center fuselage.

**PW-9 • MODEL 15 • FIGHTER • FIRST FLIGHT: JUNE 2, 1923**

The Model 15 was the first successful Boeing-designed fighter airplane. It used the arc-welding technique to fashion its steel fuselage, but it still had wooden spars and ribs. It had a wingspan of 32 feet, cruised at 142 mph, and was powered by a 435-horsepower Curtiss D-12 engine. The Navy version had the FB designation. Boeing built 157 in the PW-9/FB series between 1923 and 1928.



**DWC • TRANSPORT • FIRST FLIGHT: NOVEMBER 1923**

The design of the DT was modified for five aircraft designed to fly around the world. Four were redesignated Douglas World Cruisers and named the *Seattle*, the *Boston*, the *Chicago*, and the *New Orleans*. The *Chicago* and the *New Orleans* made the 27,553-mile trip in six months and six days. The fifth airplane was delivered to the Army Air Service for testing, later renamed *Boston II* to replace the *Boston* that had made a forced landing in the Atlantic, and completed the world-circling flight.

**O-2 • OBSERVATION BIPLANE • FIRST FLIGHT: AUTUMN 1924**

The Douglas O-2 was powered by a 435-horsepower Liberty engine. The U.S. War Department's contract for 46 of the biplanes was the largest order received by Douglas to that date, and the O-2 was the first of a series that remained in production for nine years. In 1926, a privately owned O-2BS made the first single-aircraft, single-pilot flight across Canada.

**PB-1 • MODEL 50 • PATROL FLYING BOAT (NAVY DESIGN) • FIRST FLIGHT: AUG. 5, 1925**

The Boeing PB-1 was 59 feet 4 inches long, had a wingspan of 87 feet 6 inches and, powered by two 800-horsepower Packard 2A-2500 engines, had a 2,500-mile range. It incorporated many advances that would influence later Boeing airplanes, including a partly metal fuselage, wing spars of welded-steel tubes, and an improved aileron.

**The Commuter • PRIVATE TRANSPORT • FIRST FLIGHT: JANUARY 1926**

Douglas designed the Commuter as an inexpensive light aircraft for private use. The small two-seat aircraft had a 37-foot wingspan and was the first airplane to use the Clark-Y aerofoil. It did not find a market and it remained experimental.

**T2D-1 • TORPEDO BOMBER • FIRST FLIGHT: JAN. 27, 1927**

The 42-foot-long T2D-1 was the first twin-engine Douglas airplane and could land and take off from both shore bases and, when fitted with floats, from water. Powered by two 525-horsepower Wright radial engines, it could fly 124 mph. Douglas built 30 in the series, and they served the Navy until 1937.

**Model 40A • MAIL AND PASSENGER AIRPLANE • FIRST FLIGHT: MAY 20, 1927**

The Boeing Model 40A used an air-cooled 420-horsepower Pratt & Whitney (P&W) Wasp engine that was 200 pounds lighter than the water-cooled engines powering its competitors. It won a U.S. Air Mail contract for the route between San Francisco and Chicago because it could carry more payload. It was 33 feet long, and its top speed was 128 mph. All 24 Model 40As built were ready to fly July 1, 1927, and because they could carry two people as well as mail, became the first Boeing passenger planes.



**F4B/P-12 • MODELS 99/102 • FIGHTER • FIRST FLIGHT: JUNE 25, 1928**

Models 83 and 89, prototypes for the famous F4B/P-12 series, were first built at Boeing company expense to demonstrate biplane improvements. The 20-foot 1-inch-long fuselage had bolted aluminum tubing in place of welded steel tubing. Powered by a 450-horsepower P&W R-1340B Wasp engine, F4B/P-12 fighters had a top speed of 178 mph. Derivatives were the most widely used fighters between the two world wars.

**Model 80 • COMMERCIAL TRANSPORT • FIRST FLIGHT: JULY 27, 1928**

The Boeing Model 80 was one of the most luxurious air transports of its time. The fabric-covered fuselage included 12 leather passenger seats, elegant reading lamps, and forced-air ventilation. The 56-foot 6-inch-long biplane, powered by three 525-horsepower P&W Hornet engines, had a cruising speed of 125 mph and could fly up to 14,000 feet.

**The Doodlebug • RESEARCH VEHICLE • FIRST FLIGHT: NOV. 15, 1929**

The first McDonnell airplane was the 21-foot 6-inch-long monoplane Doodlebug. McDonnell built the single model to win the \$100,000 prize in the Daniel Guggenheim International Safe Aircraft Competition. An accident and the Depression kept the airplane from entering the contest. McDonnell took the airplane around the country flying for various air shows, then sold it to the National Advisory Committee for Aeronautics (NACA, now NASA), which used it as a test airplane.

**Monomail • MODELS 200/221 • FIRST FLIGHT: MAY 6, 1930**

The Boeing Model 200 was built as a mailplane and the Model 221 as a mail and passenger plane. The two Monomails' revolutionary design reduced air resistance with its smooth, all-metal construction, retractable wheels, wing without struts set below the fuselage, and antidiag cowling over the air-cooled 575-horsepower P&W Hornet B engine. They were 41 feet 10 inches long and cruised at 135 mph.

**Dolphin • MILITARY AMPHIBIAN • FIRST FLIGHT (SINBAD): JULY 1930**

The 43-foot 10-inch-long Dolphin was the next version of the single luxury air yacht called Sinbad. The Sinbad had no civilian buyers but was finally sold to the U.S. Coast Guard. Douglas sold 59 Dolphins either custom-built for each civil customer or produced in small batches for the military. One was sold to William Boeing, who called it Rover. The amphibians were high-wing monoplanes with two 300- to 450-horsepower Wright air-cooled radial engines mounted above the wing.

**XP-9 • MODEL 96 • FIGHTER • FIRST FLIGHT: NOV. 18, 1930**

The 25-foot 2-inch-long XP-9 was the first Boeing monoplane fighter, and its single wing was supported by struts. Powered by a 600-horsepower Curtiss Conqueror engine, it could cruise at 180 mph. Only one was built.





**Y1B-9/B-9 • BOMBER • FIRST FLIGHT: APRIL 13, 1931**

The structural and aerodynamic features of the Monomail were applied to the B-9 bombers built at Boeing company expense to show their design potential to the military. Powered by either two 600-horsepower Curtiss liquid-cooled engines or two 575-horsepower P&W Hornet radial engines, the 51-foot 5-inch-long B-9 could fly 186 mph.

**P-26 • MODELS 248/266 • PEASHOOTER • FIGHTER • FIRST FLIGHT: MARCH 20, 1932**

The P-26 fighter, the first Boeing all-metal, low-wing monoplane fighter with its wings braced by wires, rather than struts, drew heavily on the Monomail design. Powered by a 600-horsepower P&W Wasp engine, the 23-foot 7-inch-long airplane could fly 234 mph. Its initial high landing speeds were reduced by the addition of wing flaps in the production models. The Army ordered 126 production-model P-26s, and Boeing built 12 for export.

**Gamma • UTILITY TRANSPORT • FIRST FLIGHT: AUGUST 1932**

Jack Northrop returned to Douglas to build low-wing passenger transports. These included 61 Gammas and 12 Deltas. The company built 49 Gammas for China and custom built the others for private owners, including the Texas Company (later Texaco). The 30-foot-long Gamma, powered by a 785-horsepower Wright Whirlwind GR-1510 14-cylinder air-cooled radial engine, could fly 248 mph and had a range of 2,500 miles. In 1935, a Gamma, the *Polar Star*, was the first airplane to cross the Antarctic continent.

**Model 247 • COMMERCIAL TRANSPORT • FIRST FLIGHT: FEB. 8, 1933**

The revolutionary all-metal twin-engine Boeing Model 247 was powered by two 500-horsepower P&W Wasp engines. Its innovations included a gyro panel for instrument flying, an autopilot, pneumatically operated deicing equipment, a variable-pitch propeller, and retractable landing gear. It had a top speed of 200 mph and a 745-mile range. It was 51 feet 7 inches long and could carry a crew of three, 10 passengers, and 400 pounds of mail. Boeing made 75 Model 247s. During World War II, some were converted into military transports and trainers.

**DC-1 • COMMERCIAL TRANSPORT • FIRST FLIGHT: JULY 1, 1933**

The DC-1 was the first in a long line of Douglas monoplane commercial transports. Howard Hughes bought the single 60-foot DC-1 in 1936. He later sold it to a Frenchman who sold it to Spain. Its production version, the 62-foot-long DC-2, first flew May 11, 1934. It was powered by two 875-horsepower Wright Cyclone engines, had a range of a 1,000 miles, and could fly 200 mph. Douglas built 156 DC-2s in commercial and military versions for U.S. and foreign airlines and for armed forces in this country and abroad.

**PT-13/-17 NS/N2S • STEARMAN KAYDET • WICHITA MODEL 75 • TRAINER • FIRST FLIGHT: NOV. 26, 1934**

The Stearman Kaydet was the most-produced biplane of all time and was the Army and Navy's primary trainer during World War II. Boeing built 8,584 Kaydets in all versions, plus the equivalent of 2,000 more in spare parts between 1936 and 1944. The two-seat Kaydet started in Wichita as a Model 70 in 1934, with fabric-covered wooden wings.



**NA-16 • BASIC TRAINER • FIRST FLIGHT: APRIL 1, 1935**

The last prototype airplane built at the General Aviation plant in Dundalk, Md., was for the NA-16 trainer series, later produced in California. The low-wing monoplane used a 600-horsepower P&W R1340 engine and had a fixed undercarriage. It was made mostly of metal, but still used some fabric on the rear fuselage. The production versions launched North American as a manufacturer of training aircraft, starting with 267 BT-9s and 330 BC-1 "basic combat" trainers.

**TBD Devastator • TORPEDO BOMBER • FIRST FLIGHT: APRIL 15, 1935**

The first of 130 Douglas Devastators entered service aboard the *USS Saratoga* in October 1937. When the Japanese attacked Pearl Harbor Dec. 7, 1941, 100 Devastators were in service and among the first to see action. The 35-foot-long Devastator had a retractable undercarriage and power-folding wings and was among the first low-wing monoplane carrier aircraft.

**B-18 • BOLO • BOMBER • FIRST FLIGHT: APRIL 1935**

The twin-engine Bolo was Douglas' first medium bomber. It used the wing and systems of the OC-2 transport, was 56 feet 8 inches long, was powered by two 930-horsepower Wright R-1820-45 engines, could fly 217 mph, held a crew of six, and was armed with three hand-held .30-inch machine guns and 2,000 pounds of bombs. Douglas built 370 production-model Bolos, and they constituted most of the bombers deployed outside the country as the United States entered World War II.

**B-17 • MOEL 299 • FLYING FORTRESS • BOMBER • FIRST FLIGHT: JULY 28, 1935**

Described by General H.H. "Hap" Arnold as the "backbone of our worldwide aerial offensive," the Boeing B-17 Flying Fortress served in every World War II combat zone. Best known for daylight bombing raids, B-17s dropped 640,036 tons of bombs on designated targets. Between 1935 and 1945, 12,731 B-17 Flying Fortress bombers were rolled out by Boeing, Douglas, and Lockheed's Vega division plants across the country.

**O-46A • OBSERVATION MONOPLANE • FIRST FLIGHT: OCTOBER 1935**

Douglas' first observation monoplane was the XO-31, which led to the O-46, the most popular in the series. Douglas delivered 90 O-46s to the Army Air Corps. Powered by a 725-horsepower P&W air-cooled radial engine, the 34-foot 6-inch-long O-46A could fly 200 mph and had a range of 435 miles.

**O-47 • OBSERVATION AIRCRAFT • FIRST FLIGHT: NOVEMBER 1935**

The North American O-47 observation biplane was 33 feet 7 inches long and had room for two crewmembers. An observer rode in a glass enclosure under the cockpit. The full-cantilevered monoplane had a 46-foot 4-inch wingspan, a stressed metal skin, and retractable landing gear. It had a range of 400 miles, could fly 221 mph, and was powered by a 1,000-horsepower Wright Cyclone R-1820-49 engine.



**DC-3 • COMMERCIAL AIRCRAFT • FIRST FLIGHT: DEC. 17, 1935**

Douglas produced 10,629 DC-3s in its commercial and its military versions. The commercial DC-3 provided air travelers with comfortable day travel, and the sleeper version, the Douglas Sleeper Transport, had bunks like a Pullman railway coach. The DC-3 military derivatives, including the popular C-47 Skytrain, served in many capacities all over the world. The 64-foot 5-inch-long DC-3 could fly 192 mph and had a range of 1,495 miles.

**A-17/BA • LIGHT ATTACK BOMBER • FIRST FLIGHT: DECEMBER 1935**

The 1935 contract for 110 A-17 attack bombers from the Northrop division of Douglas launched the company as a producer of light tactical bombers. The A-17, a low-wing monoplane, 31 feet 8 inches long, was powered by a 750-horsepower R-1535-11 engine and was armed with five .30-inch machine guns and 1,200 pounds of bombs. It had a crew of two, could fly 170 mph, and had a 650-mile range. In all, Douglas built 352 A-17s. In addition to flying with the U.S. Army Air Corps, they flew for air forces around the world.

**NA-21 • DRAGON • BOMBER • FIRST FLIGHT: DEC. 22, 1936**

The experimental NA-21 Dragon was North American's first venture into multiengine design. It was a high-altitude bomber with power gun turrets and was capable of carrying a large bombload. It was powered by two 1,200-horsepower, turbo-supercharged P&W R-2180-1 Hornet engines with F-10 turbo-superchargers. The Air Corps bought the NA-21 in 1939 and redesignated it the XB-21.

**XB-15 • MODEL 294 • BOMBER • FIRST FLIGHT: OCT. 15, 1937**

When the mammoth experimental Boeing XB-15 made its first flight, it was the largest and heaviest bomber ever built in the United States. It had a wingspan of 149 feet, was 87 feet 7 inches long, and weighed 70,706 pounds. Powered by four 850-horsepower P&W R-1830-11 Twin Wasp engines, it cruised at 152 mph and had a range of 5,130 miles. The crew of 10, using passageways inside the wing, could make repairs while the airplane was in flight. During the war, it became a cargo carrier, designated the XC-105.

**Model 314 • CLIPPER • FLYING BOAT • FIRST FLIGHT: JUNE 7, 1938**

The Boeing Clipper was the largest passenger transport of its time. It could carry 74 passengers in comfortable surroundings that included a lounge, a dining salon, and a bridal suite. Its seats could convert into 40 bunks. The XB-15 bomber's wings and nacelles were used on the Clipper's towering whale-shaped body. The 106-foot-long Clipper, with a 152-foot wingspan, had a top speed of 199 mph. Boeing sold 12 Clippers to Pan American Airways and, on June 28, 1939, a Clipper made the first scheduled transatlantic flight.

**AT-6 • TEXAN (HARVARD) • TRAINER • FIRST FLIGHT (NA-49): SEPT. 28, 1938**

North American built more than 15,800 Texans and SNJs (the Navy version) beginning in 1938 with the first NA-49 Harvard for the British Royal Air Force. North American started deliveries of the AT-6 to the U.S. Army Air Corps Feb. 10, 1940. The rugged trainers served with American military services for 25 years and in more than 30 foreign countries. The AT-6A had a wingspan of 42 feet, could fly 205 mph, and was powered by a 550-horsepower P&W Wasp engine.



**Model 307/C-75 • STRATOLINER • TRANSPORT • FIRST FLIGHT: DEC. 31, 1938**

The Boeing Stratoliner, 74 feet 4 inches long, was the world's first high-altitude commercial transport and, in 1940, started scheduled domestic transcontinental service. Cabin pressurization allowed the airplane to fly at 20,000 feet, higher than any other transport of the time. Its 12-foot-wide cabin held 33 passengers, with berths for overnight travel. Ten were built. In 1942, five were drafted into the Army Transport Command as C-75s.

**BT-14 • YALE BASIC • TRAINER • FIRST FLIGHT: FEB. 10, 1939**

North American built 1,230 Yales, and the last variation of the family was the BT-14. The BT-14s were 27 feet 7 inches long, weighed 4,470 pounds, and had a range of 735 miles. They were powered by a 450-horsepower P&W R985 engine.

**DB-7/A-20 • BOSTON/HAVOC • ATTACK BOMBER • FIRST FLIGHT: AUG. 17, 1939**

The Douglas DB-7/A-20 Havoc, a mid-wing, twin-engine, three-place medium bomber, was known as the Boston when it was built for England's Royal Air Force. A total of 7,477 DB-7/A-20s were built. With a 61-foot 4-inch wingspan, the A-20C had a top speed of 340 mph. It was powered by two 1,600-horsepower Wright R-2600-23 engines, had a crew of three, and was armed with a 2,000-pound bombload and nine machine guns.

**SBD/A-24 • DAUNTLESS • DIVE BOMBER • FIRST FLIGHT: MAY 1, 1940**

Douglas delivered 5,936 SBDs and A-24s between 1940 and the end of production in July 1944. The Dauntless was based on the Northrop Model 8 attack bomber and featured "Swiss cheese" flaps (dive brakes punched with 3-inch holes) so it had pinpoint accuracy diving, dropping a bomb, and pulling out of a near-vertical dive. The Dauntless was 33 feet long and flew 252 mph. It served with the U.S. Navy, Marine Corps, Army Air Forces, and the air forces in New Zealand and Mexico.

**B-25 • MITCHELL • BOMBER • FIRST FLIGHT: AUG. 19, 1940**

North American built more than 11,000 B-25s for the U.S. Army Air Forces and the U.S. Navy, which called it the B-25, plus 50 each for China and Great Britain. The B-25 bomber had a wingspan of 67 feet and was 52 feet 11 inches long. It had a range of 1,500 miles, could fly 284 mph, and was powered by two 1,700-horsepower Wright Cyclone GR-2600-13 engines. One version, the B-25H, was the most heavily armed attack bomber of its time, with a 75-millimeter cannon and fourteen .50-caliber machine guns.

**P-51 • MUSTANG • FIGHTER • FIRST FLIGHT: MAY 20, 1941**

The P-51 Mustang was initially designed for the British Royal Air Force for fighter-reconnaissance and was the first single-engine aircraft based in England to penetrate Nazi Germany. North American built 15,575 P-51 Mustangs. Superior aerodynamics allowed them to outperform enemy fighters. The P-51D Mustang had a wingspan of 37 feet and was 32 feet long. Powered by one 1,490-horsepower Rolls-Royce V-1650-3 engine, it flew 437 mph with a range of 2,300 miles.





**C-47 • SKYTRAIN • MILITARY TRANSPORT • FIRST DELIVERED: DEC. 23, 1941**

The Douglas C-47 was based on the DC-3, but its wingspan was 6 inches longer and it had large cargo doors, reinforced fuselage, and cargo hooks under the center wing section. It had a crew of three and could carry up to 6,000 pounds of cargo or 28 troops. Other variants included the AC-47D gunship, the EC-47 electronic reconnaissance aircraft, the EC-47Q antiaircraft systems evaluation aircraft, the C-53 Skytrooper, and the R4D for the U.S. Navy and Marine Corps.

**DC-4/C-54/R5D • SKYMASTER • TRANSPORT • FIRST FLIGHT: FEB. 14, 1942**

The single Douglas DC-4E of 1938 gave rise to the DC-4, which carried 44 passengers at more than 200 mph. The DC-4, introduced by the U.S. Army as the C-54 Skymaster in 1942, was not put into commercial service until 1946. Douglas built 1,241 DC-4/C-54s. A C-54C, called "The Sacred Cow" by the White House Press corps, was the presidential aircraft ordered for President Franklin D. Roosevelt. During World War II, C-54s made 79,642 transoceanic flights. C-54s remained in service for more than five decades, with some still flying in 1998.

**A-26/B-26 • INVADER • LIGHT BOMBER • FIRST FLIGHT: JULY 10, 1942**

Douglas started the A-26/B-26 Invader in 1941 to follow the A-20/DB-7 Havoc bomber. When the famous Martin B-26 Marauder retired, the Air Force deleted the designation "A" for attack and gave the Invader the B-26 designation. Douglas built 2,503 Invaders, and they served in World War II, Korea, and Vietnam. The last U.S. military Invader was retired in 1972 and donated to the National Air and Space Museum.

**B-29 • MODEL 345 • SUPERFORTRESS • BOMBER • FIRST FLIGHT: SEPT. 21, 1942**

The Boeing B-29 was the most technologically advanced airplane program during World War II. At 105,000 pounds, it was the world's heaviest production airplane. The B-29 used state-of-the-art 2,200-horsepower Wright R3350 twin-row radial engines, each fitted with two turbosuperchargers. It was the first bomber with crew-cabin pressurization and remotely controlled power turrets. By production end, 3,970 B-29s had been built. World War II ended when two B-29s, the *Enola Gay* and *Bockscar*, dropped atomic bombs on Hiroshima and Nagasaki.

*Boeing*

**XP-67 • FIGHTER • FIRST FLIGHT: JAN. 6, 1944**

During 1941, the McDonnell company worked on its first Army Air Forces contract to design and build a twin-engine fighter. Engineers tried to improve the airplane's aerodynamics by merging the center fuselage with rear portions of the engine nacelles, resulting in the XP-67's unique bat-like shape. Nonetheless, it was 200 mph slower than required and was McDonnell's first, and last, propeller-powered fighter.

*McDONNELL Aircraft Corporation*

**Gargoyle • MISSILE • FIRST FLIGHT: MARCH 1944**

McDonnell's Gargoyle started life as a radio-controlled glide bomb but was given a liquid-propellant rocket engine in March 1944, at the Navy's request. McDonnell delivered 250 Gargoyles. The war ended, and the Gargoyle became a test vehicle without seeing action. It evolved into the Katydid target drone. Both used traditional wing configurations. The third development in this line was the Kingfisher, an air-to-underwater attack missile.

*McDONNELL Aircraft Corporation*



**WAC • CORPORAL • MISSILE • FIRST FLIGHT (BABY WAC): JULY 3, 1944**

The WAC Corporal started as the Baby WAC, only one-fifth the size of the final 21-foot WAC Corporal. On Jan. 24, 1949, a German V-2 was combined with a Douglas WAC Corporal to fly 250 miles high at 5,000 mph, faster than any vehicle before it. The launch was the first from what has now become the Kennedy Space Center at Cape Canaveral, Fla.

**C-97 • MODEL 367 • STRATOFREIGHTER • MILITARY TRANSPORT • FIRST FLIGHT: NOV. 9, 1944**

The Boeing C-97 Stratofreighter was the high-flying cargo plane and transport that evolved from the B-29 bomber. The pressurized Model 367 had a double-lobe fuselage consisting of two intersecting circular sections. Cargo was loaded through clamshell doors in the belly using a built-in ramp and a hoist. The KC-97 aerial tanker versions dominated the series and became a crucial element of the Strategic Air Command. Boeing built 888 C-97s in all versions.

*Boeing*

**FH-1 • PHANTOM • FIGHTER • FIRST FLIGHT: JAN. 26, 1945**

The McDonnell FH-1 Phantom was the first all-jet airplane to be ordered into production by the Navy, the first combat jet aircraft to operate from the flight deck of a U.S. aircraft carrier, and the Navy's first airplane to fly 500 mph. McDonnell built 62 Phantoms between 1945 and 1947, and they flew for both the Marine Corps and the Navy. The Phantom put the company on a firm financial foundation in the difficult postwar period.

*McDONNELL Aircraft Corporation*

**AD/A-1 series • SKYRAIDER • ATTACK BOMBER • FIRST FLIGHT: MARCH 18, 1945**

Before production ceased in 1957, Douglas built 3,180 Skyraiders in 28 variations. The Skyraider had straight, low-mounted wings with a 50-foot wingspan, was powered by a 2,700-horsepower Wright R-3350 engine, and had a maximum speed of more than 300 mph. It could deliver 8,000 pounds of bombs with dive-bombing precision against difficult targets. In 1964, it was modified for extensive service in the Vietnam War, redesignated the A-1E/A-1H, and used by the U.S. Navy and the U.S. and South Vietnamese air forces.

**P-82/F-82 • TWIN MUSTANG • FIGHTER • FIRST FLIGHT: JUNE 15, 1945**

North American built 272 Twin Mustangs. It looked like two Mustang fuselages on one wing. Its twin cockpits allowed a pilot and copilot to share the workload on long-range missions. During the Korean conflict, the first three North Korean airplanes destroyed by U.S. forces were shot down by F-82G interceptors. The Twin Mustang had a wingspan of 51 feet 3 inches and was 39 feet long. It was adapted as a fighter, long-range escort, reconnaissance airplane, night fighter, attack bomber, rocket fighter, and interceptor.

**GAPA • MODELS 600 TO 602 • MISSILE • FIRST FLIGHT: JAN. 13, 1946**

Ground-to-Air Pilotless Aircraft (GAPA) was the first Boeing missile, and it pioneered the company's efforts in rocket-propulsion technology. GAPA was 16 feet long and 10 inches in diameter. It traveled at supersonic speeds to intercept aircraft flying up to 700 mph at altitudes of 8,000 to 60,000 feet.

*Boeing*



**DC-6 • TRANSPORT • FIRST FLIGHT: FEB. 15, 1946**

The Douglas DC-6 was one of the first airplanes to fly a regularly scheduled around-the-world route. With a wingspan of 117 feet 6 inches, powered by four 2,400-horsepower P&W R2800 engines, it held 52 to 102 passengers and flew more than 300 mph. Its military version was the C-118 Liftmaster. The 29th DC-6 was adapted as an executive aircraft for President Harry Truman, designated VC-118, and named *The Independence* after Truman's hometown. Douglas built 704 DC-6s.

**L-17 • NAVION • FIRST FLIGHT: APRIL 1946**

The 27.5-foot-long, single-engine North American Navion (NA-154) was originally designed for civilian use and was still flown privately through the 1990s—although North American lost money on the 1,109 Navions it built. In 1947, Ryan Aeronautical Corp. bought the design and built 1,240 more Navions, including the military L-17s used as transports and for reconnaissance. In 1961, the Navion Aircraft Corp. built 120 Rangemaster Navions.

**FJ • FURY • JET FIGHTER • FIRST FLIGHT: SEP. 11, 1946**

The North American Fury fighter was a short, squat airplane looking much like a high-flying bomb. Extra fuel was stored in wingtip tanks. A special feature was the bending nose gear, so the fighter could "kneel down" on the crowded deck of an aircraft carrier. The Fury was the first jet fighter to complete an operational tour at sea. A total of 33 straight-wing Furies were built at first, but the next variants had swept wings. These later swept-wing versions filled the Navy's demand for an aircraft similar to the F-86.

**F2H • BANSHEE • FIGHTER • FIRST FLIGHT: JAN. 11, 1947**

The McDonnell F2H Banshee went into combat in 1951 and served as one of the principal fighters with the Navy's Seventh Fleet for the duration of the Korean conflict. Powered by two 3,250-pound-thrust turbojets, the Banshee carried bombs as well as rockets and cannons. McDonnell built 895 Banshees, and they remained in U.S. service until 1959. In November 1955, Canada acquired 39 Banshees. Banshees were built in day fighter, night fighter, and photoreconnaissance versions.

**B-45 • TORNADO • BOMBER • FIRST FLIGHT: FEB. 24, 1947**

North American's straight-wing B-45 Tornado, designed during 1944 and 1945, was the first jet bomber in service with the Air Force and the first four-jet airplane to fly in the United States. Versions included the longer-range B-45C with wingtip tanks and the photoreconnaissance version, the RB-45C. Rated as a light bomber by modern-day standards, it was the first four-jet aircraft to drop an atom bomb and the first to be refueled in midair. It had a wingspan of 89 feet, and it was 75 feet 11 inches long.

**B-50 • MODEL 345-2-1 • BOMBER • FIRST FLIGHT: JUNE 25, 1947**

The Boeing B-50 series began as the B-29D, but after extensive improvements, the bomber was redesignated B-50A. It used four 3,500-horsepower P&W Wasp Major engines to have 59 percent more power than the B-29. In 1949, a B-50A, the *Lucky Lady II*, made the first nonstop flight around the world using aerial refueling. Boeing built 371 B-50s in all versions between 1947 and 1953.



**Stratocruiser • MODEL 377 • COMMERCIAL TRANSPORT • FIRST FLIGHT: JULY 8, 1947**

The Boeing Stratocruiser was the civilian version of the C-97 military transport. Its upper deck was reconfigured as an elegant 100-seat airliner. The seats could be converted into bunks. A circular stairway led to a lower-deck luxury lounge. Boeing built 56 Stratocruisers between 1947 and 1950. They served with six airlines, primarily on transoceanic routes. During the early 1960s, some Stratocruisers were modified into the "Guppy" series when Aero Space Lines ballooned the fuselages to carry large spacecraft sections.

BOEING

**XH-20 • LITTLE HENRY • RESEARCH HELICOPTER • FIRST FLIGHT: AUG. 29, 1947**

The McDonnell *Little Henry* proved that helicopters could fly using ramjet engines located in the tips of their rotor blades. The tip-driven rotor eliminated the need for a torque-compensating tail rotor. It did not need a transmission and was controlled with a rudder. However, ramjets were too noisy and used too much fuel, so only two test models were built.

McDONNELL Aircraft Corporation

**F-86 • SABRE JET • FIGHTER • FIRST FLIGHT: OCT. 1, 1947**

The North American F-86 Sabre Jet was America's first single-seat, swept-wing jet fighter. It was the world's first-line fighter for more than a decade after it was designed. More than 6,000 Sabre Jets were built worldwide. During the Korean conflict, the Sabre Jet flew 82,177 sorties during 32 months of combat and troop support. The version built for the Navy and Marine Corps was called the FJ-2 Fury. In 1948, the Sabre Jet set a new world speed record of 671 mph.

**B-47 • MODEL 450 • STRATOJET • BOMBER • FIRST FLIGHT: DEC. 17, 1947**

The six-engine Boeing B-47 was America's first multengine swept-wing jet bomber. The thin 116-foot wing was extraordinarily flexible and swept back at a 35-degree angle. The Stratojet used 18 small rocket units in the fuselage for jet-assisted takeoff (JATO), and parachutes cut its landing speeds. Later models were powered by 5,200-pound-thrust General Electric axial-flow jet engines, and top speeds were 600 mph. A total of 2,032 B-47s in all versions were built.

BOEING

**F3D/F-10 • SKYKNIGHT • FIGHTER • FIRST FLIGHT: MARCH 23, 1948**

The Douglas F3D Skyknight was the world's first jet fighter designed for use as a carrier-based night fighter. Its radar equipment required a wider fuselage, so it was nicknamed "Willie the Whale." Douglas produced 268 Skyknights. One Marine Corps night-fighter squadron went on to rack up the best night-fighter record of the Korean conflict. Skyknights served during the Cuban Missile Crisis and the Vietnam conflict. The last was retired in 1978.

**AJ • SAVAGE • BOMBER • FIRST FLIGHT: JULY 3, 1948**

The AJ Savage was the first U.S. bomber designed especially to carry the atomic bomb. It used two P&W R-2800 engines to turn four-bladed propellers for normal takeoff and cruise flight and a J33 turbojet for accelerated takeoff or bombing run-in. It carried a crew of three and had folding wings so that it could be stored on an aircraft carrier. North American built 145 AJ Savages, including a photoreconnaissance version with a modified radome and 18 cameras.





**XF-85 • GOBLIN • PARASITE FIGHTER • FIRST FLIGHT: AUG. 23, 1948**

The McDonnell XF-85 Goblin, with its 21-foot wingspan, was the smallest jet-propelled fighter ever built. The egg-shaped Goblin had no landing gear but was launched from the bomber and recovered using a hook and a retractable trapeze under the parent airplane. For emergencies, the Goblin had a steel skid under the fuselage and small runners on its wingtips.

McDONNELL Aircraft Corporation

**NA-159/T-28 • TROJAN • TRAINER • FIRST FLIGHT: SEPT. 24, 1949**

The success of North American's Texan trainers led to the development of the NA-159. The production model, the T-28 Trojan, had tricycle-type landing gear and was the first trainer designed to transition pilots to jet aircraft. The Navy ordered 792 T-28s, 299 of which included an arrestor hook for carrier landings.

**C-124 • GLOBEMASTER II • MILITARY TRANSPORT • FIRST FLIGHT: NOV. 29, 1949**

The Douglas C-124 Globemaster II, also fondly called "Old Shakey," could carry more than 200 troops. The Air Force bought 448 C-124s, which provided airlift support in the Far East and Southeast Asia, went on resupply missions to Antarctica, evacuated refugees from the Congo, and flew many mercy flights. Although in production for only five years, the C-124 had a long and useful life. The last C-124 was phased out in 1974.

**F4D • SKYRAY • FIGHTER JET • FIRST FLIGHT: JAN. 23, 1951**

The Douglas Skyray, named after the undersea manta ray, was a Navy fighter capable of Mach 1 during a dive. Nicknamed "the 10-minute killer," it could climb to 40,000 feet in two minutes and broke five world time-to-height records. A Skyray-equipped interceptor squadron was the only Navy unit assigned to the Air Force-dominated North American Air Defense Command. Douglas built 421 Skyrays, including two prototypes.

**F3H • DEMON • FIGHTER JET • FIRST FLIGHT: AUG. 7, 1951**

The F3H Demon was McDonnell's first swept-wing fighter and the first aircraft designed to be armed only with missiles rather than guns and missiles. The carrier-based all-weather fighter entered service in 1956 and was used during the Lebanon and Quemoy crises of 1958. It was the only single-engine naval fighter McDonnell designed, and 522 were produced.

McDONNELL Aircraft Corporation

**Nike • MISSILE • FIRST TARGET-DRONE HIT: NOVEMBER 1951**

The Nike Ajax was the first operational ground-based supersonic antiaircraft missile in the United States and was deployed in a circle around key locations. It led to the Nike Hercules and Nike Zeus missiles. All existing Nike U.S. batteries were inactivated Feb. 4, 1974.



**Model 79 • BIG HENRY • UTILITY HELICOPTER • FIRST FLIGHT: MARCH 26, 1952**

The single *Big Henry* was a prototype for a large ramjet-powered utility helicopter. It flew well, at speeds of 86 mph, but the ramjet engines on the tips of the 27-foot rotor blade, like those on *Little Henry*, were too noisy and used too much fuel.


**B-52 • MODEL 464 • BOMBER • FIRST FLIGHT: APRIL 15, 1952**

The Boeing B-52 was the country's first long-range, swept-wing bomber. By 1998, it was in its fourth decade of operational service. Originally designed as an intercontinental high-altitude nuclear bomber, the B-52 was adapted to meet changing defense needs. B-52s are capable of low-level flight, conventional bombing, extended-range flights, and launching cruise missiles hundreds of miles from targets. A total of 744 B-52s was built in all versions between 1952 and 1962.


**IM-99A/-99B • MODEL 621 • BOMARC • MISSILE • FIRST FLIGHT (F-99): SEPT. 10, 1952**

The supersonic BOMARC missiles were the first missiles Boeing mass produced. Designed to destroy attacking aircraft, BOMARC had an 18-foot 2-inch wingspan and was 45 feet long and 35 inches in diameter. It was powered by 50,000-pound-thrust solid-fuel rockets and two 12,000-pound-thrust ramjets, had a range of 400 miles, and could fly at more than Mach 2. Boeing built 700 BOMARCs and 420 launch systems.


**X-3 • STILETTO • TEST AIRCRAFT • FIRST FLIGHT: SEPT. 20, 1952**

Douglas built the single experimental X-3 to test the effects of high speeds and temperatures on aircraft, investigate the use of new materials like titanium, and explore construction techniques. Its wingspan was only 22 feet 8 inches, but it was 66 feet 9 inches long and powered by two 4,900-pound-thrust, with afterburner, Westinghouse J34 jet engines. It could fly 706 mph and carried 1,200 pounds of instruments in its long, tapered nose.

**A3D/A-3/B-66 • SKYWARRIOR/DESTROYER • BOMBER • FIRST FLIGHT: OCT. 28, 1952**

The Douglas A3D Skywarrior was the Navy's first twinjet nuclear bomber. Redesignated A-3 in 1962, it had a wingspan of 72 feet 6 inches, was 74 feet 5 inches long, and weighed 70,000 pounds, so it was the largest and heaviest aircraft ever to operate from an aircraft carrier. The modified Air Force version was named the B-66 Destroyer, with an RB-66 modification for night photo, electronics, and weather reconnaissance. Douglas built 282 A-3 Skywarriors and 294 B-66 Destroyers.

**DC-7 • COMMERCIAL TRANSPORT • FIRST FLIGHT: MAY 18, 1953**

The DC-7 was the last Douglas propeller-powered transport. The four-engine, 110-passenger airplane, 108 feet 11 inches long, entered service with American Airlines in November 1953. Capable of flying more than 400 mph, it was the first commercial transport able to fly nonstop westbound across the United States against prevailing winds. Douglas built 338 DC-7s.



**F-100 • SUPER SABRE • FIGHTER • FIRST FLIGHT: MAY 25, 1953**

The North American Super Sabre was the first operational fighter in the world capable of maintaining supersonic speed in level flight. Of the 2,290 Super Sabres, 1,274 F-100Ds included the first autopilot designed for a supersonic jet. Powered by a 16,950-pound-thrust afterburning P&W J-57 jet engine, the F-100 was armed with four 20-millimeter cannons, two GAM 83A Bulldog missiles, four Sidewinder missiles, rockets, special stores, and/or 7,040 pounds of bombs.

**Redstone • ROCKET ENGINE • FIRST LAUNCH (MISSILE): AUGUST 1953**

America's first orbiting satellite, *Explorer 1*, was launched Jan. 1, 1958, using a Jupiter C rocket powered by a North American Rocketdyne Redstone engine. In May 1961, astronaut Alan Shepard became the first American in space when he was launched on a suborbital flight by a Redstone rocket engine.

**SM-64 • NAVAHO • MISSILE • FIRST FLIGHT (X-10): OCTOBER 1953**

The Navaho began with the X-10, a supersonic test vehicle used to generate data for the development of the North American Navaho SM-64 ground-to-ground missile system. North American adapted Navaho's navigation unit, built by North American's Autonetics Division, for the Nautilus submarine that made the first under-ice passage of the North Pole in 1956.

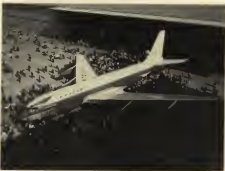
**A4D/A-4 • SKYHAWK • LIGHT ATTACK BOMBER • FIRST FLIGHT: JUNE 22, 1954**

The Douglas Skyhawk was affectionately nicknamed Heinemann's Hot Rod (after Douglas designer Ed Heinemann), the Bantam Bomber, Mighty Mite, and Scooter. In production between 1954 and 1979, 2,960 Skyhawks were built. The Navy's Blue Angels flight demonstration squadron flew the single-engine A-4 Skyhawk II from 1974 to 1986. The Skyhawk was scheduled to remain active with several air forces into the 2000s.

**Model 367-80 • DASH 80 • JET TRANSPORT/TANKER • FIRST FLIGHT: JULY 15, 1954**

The 367-80 was the prototype for the first Boeing commercial jet transport, the 707, and the military jet aerial tanker KC-135. It was 128 feet long, with a 130-foot wingspan, and it was powered by four 10,000-pound-thrust P&W JT3 turbojet engines. In 1955, the Dash 80 flew from Seattle to Washington, D.C., in less than four hours. In 1972, the Dash 80 became part of the Smithsonian's National Air and Space Museum collection.

BOEING

**F-101 • VOODOO • FIGHTER • FIRST FLIGHT: SEPT. 29, 1954**

The McDonnell Voodoo was a supersonic fighter designed to escort bombers, serve as a fighter bomber, an all-weather interceptor, and a photoreconnaissance aircraft. It served during the Cuban Missile Crisis and the Vietnam War. It began as Model XF-88 in 1948. The two prototypes evolved into the F-101 Voodoo, equipped with powerful 15,000-pound-thrust P&W J57 axial-flow turbojets. In 1957, an F-101A set a world speed record of 1,207 mph. McDonnell delivered 807 F-101 Voodoos, the last of which was retired in 1986.



**C-133 • CARGOMASTER • MILITARY TRANSPORT • FIRST FLIGHT: APRIL 23, 1956**

The Douglas C-133 Cargomaster, a four-engine, turboprop transport, could carry 52,000 pounds for 4,000 miles. It carried fully assembled tanks and transported the Douglas-built Thor intermediate-range ballistic missile (IRBM); NASA used one to carry space boosters and to drop test the early space capsules. Douglas built 50 Cargomasters.

**KC-135 • MODEL 717 • STRATOTANKER • FIRST FLIGHT: AUG. 31, 1956**

The KC-135 was the only jet airplane designed specifically for aerial refueling. More than 600 of the 732 KC-135 tankers built remained in service into the 1990s. The KC-135's aerial refueling equipment was in the lower deck, leaving the upper deck clear for 25 tons of cargo or 80 troops. During the Persian Gulf conflict, the KC-135s transferred 278 million pounds of fuel.

BOEING

**MB-1/Air 2 • GENIE • AIR-TO-AIR MISSILE • FIRST TEST: JULY 19, 1957**

The Douglas-designed Genie was an air-launched rocket carrier by the McDonnell F-101 Voodoo. It had a 1.5-kiloton nuclear warhead and was the first nuclear-armed interceptor rocket to be tested. It was 9 feet 7 inches long, had a speed of Mach 3, weighed 820 pounds, and had a range of six miles. Thousands of Genies were produced before the production line closed in 1962.

**Thor • MISSILE • FIRST SUCCESSFUL LAUNCH: SEPT. 20, 1957**

The Thor IRBM provided nuclear deterrence before ICBMs were ready. It passed its capability tests in 1958. Thor missiles later were reconfigured as launch vehicles for the Air Force and NASA, providing technology for current launch systems. The Rocketdyne division of North American provided the propulsion system for the Thor missile and subsequent space launch vehicles.

**Model 707 • COMMERCIAL TRANSPORT • FIRST FLIGHT: DEC. 20, 1957**

The Model 707 was the first in the long line of Boeing commercial jet airliners. Its wingspan was 130 feet 10 inches, and it had more than 100 windows. Later versions could fly up to 189 passengers 6,000 miles at 600 mph. The Air Force bought three 707-120s and converted them into VIP transports. When the president was aboard, it was called "Air Force One." Later, two 707-320s were specifically configured as Air Force One presidential airplanes. A total of 855 707s were delivered between 1957 and 1992.

BOEING

**T-2 • BUCKEYE • TRAINER • FIRST FLIGHT: JAN. 31, 1958**

North American's first jet trainer, the Buckeye, was built at the Columbus, Ohio, plant and took its name from the state's nickname. Its primary customer was the U.S. Navy and it was used for both basic and advanced training. First designated the T2J-1, it had a 38-foot 1-inch wingspan. Later versions were used as multipurpose aircraft and designated the T-2. North American built 609 Buckeyes until 1973. Some remained in service through the 1990s.





**F-4 • PHANTOM II • FIGHTER • FIRST FLIGHT: MAY 27, 1958**

The McDonnell two-place, twinjet, all-weather F-4 Phantom II had top speeds more than twice that of sound. Just 31 months after its first flight, the F4H was the Navy's fastest and highest flying fighter and had the longest range. Both the Navy Blue Angels and the Air Force Thunderbirds flew the F-4 from 1969 to 1973. A total of 5,195 F-4 Phantoms were built, the last delivered in 1979. By 1997, at least 1,000 were still in service around the world.

McDONNELL Douglas Corporation

**DC-8 • COMMERCIAL TRANSPORT • FIRST FLIGHT: MAY 30, 1958**

Powered by four 13,500-pound-thrust P&W JT3C turbojets, the first Douglas jet transport could fly more than 600 mph. Douglas built 556 DC-8s in seven major variants over 14 years of production. In its largest version, the Series 63, it proved capable of flying more than 4,500 miles nonstop carrying 259 passengers. Its versatility allowed it to be fitted with high-bypass-ratio turbofan engines by another company and called the Series 70.

**A3J/A-5 • VIGILANTE • BOMBER/RECONNAISSANCE • FIRST FLIGHT: AUG. 31, 1958**

North America's Mach 2 carrier-based bomber, the Vigilante, on Dec. 31, 1961, set an altitude record of 91,450 feet with a 2,402-pound payload. North America built 179 Vigilantes. Redesignated the A-5, the Vigilante's first full deployment was in August 1962, with the inaugural cruise of the Navy's first nuclear aircraft carrier, the *USS Enterprise*. In 1964, the Vigilantes were reconfigured as RA-5C reconnaissance aircraft and served during the Vietnam War.

**T-39 • SABLELINER • MILITARY TRAINER/BUSINESS JET • FIRST FLIGHT: SEPT. 16, 1958**

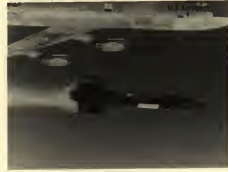
In 1965, the Sableliner was the first jet aircraft equipped with automatic terrain-following capability. North America built 600 of the 47-foot-long twinjets, 212 as military T-39s for the Navy, Air Force, and Marine Corps.

**GAM-77 • HOUND DOG • MISSILE • FIRST FLIGHT: APRIL 23, 1959**

North America's single-stage supersonic, air-launched missile for the Strategic Air Command was named after Elvis Presley's hit song and could be carried two at a time under wings of B-52 bombers. Hound Dogs allowed B-52s to attack targets from up to 700 miles away and avoid flying into enemy defenses. The Hound Dog's navigation and fuel systems were integrated and compatible with the B-52 so the missiles could be refueled by B-52s, provide fuel back and, if necessary, provide added thrust for takeoff.

**X-15 • RESEARCH VEHICLE • FIRST FLIGHT: JUNE 8, 1959**

The X-15 hypersonic research aircraft program started in 1956 and ended on Oct. 24, 1968, after 199 flights. It reached speeds of Mach 6.7 and holds the unofficial world's speed record for a human-controlled rocket-powered aircraft. It was 12 feet 2 inches high and was powered by a Reaction Motors, Inc., XLR-99 rocket engine with more than 50,000 pounds of thrust.



**Model 720 • COMMERCIAL TRANSPORT • FIRST FLIGHT: NOV. 23, 1959**

The Boeing 720 was basically a 707 modified for shorter runways and short-to-medium airline routes. It carried 167 passengers and was a lighter airplane than the 707 partly because its 136-foot 9-inch fuselage was 9 feet shorter than the 707's and it carried less fuel. Boeing built 154 Model 720s between 1957 and 1967.

BOEING

**Delta • LAUNCH VEHICLE • FIRST FLIGHT: MAY 13, 1960**

The Delta is an expendable launch vehicle, and its first version was a modification of the Douglas Thor IRBM. Its first successful launch in August 1960 placed the first passive communications satellite in orbit. Using North American Rocketdyne engines, it launched the first commercial communications satellite, the first Air Force Global Positioning System satellites, and Pioneer 6. The next generation of Mars probes flew on Delta II rockets in December 1998 and January 1999.

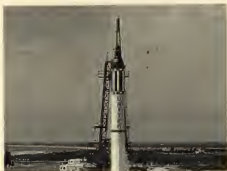
**LGM-30A/B • MINUTEMAN • ICBM • FIRST FLIGHT: FEB. 1, 1961**

The Minuteman weapons system was a long-range, solid-fuel, three-stage intercontinental ballistic missile (ICBM) capable of carrying multiple nuclear warheads. By April 1967, 1,000 Minuteman missiles were operational and installed at six sites across the country. The missile had a range of more than 6,000 miles and was constantly upgraded until it had three reentry vehicles, each with four-target capability.

BOEING

**Mercury • SPACE CAPSULE • FIRST CREWED FLIGHT: MAY 5, 1961**

Project Mercury, a nationwide team effort led by NASA, gathered data on the psychological and physiological effects on astronauts in space. NASA selected McDonnell to build the spacecraft Jan. 12, 1959. The one-person capsule was 6 feet 5 inches in diameter and weighed 3,649 pounds at launch. Twenty vehicles were delivered, and six carried astronauts into space. On May 5, 1961, Alan Shepard, aboard a Mercury capsule, was the first American in space.

McDONNELL *Sheep Corporation***CH-47 • CHINOOK • MILITARY HELICOPTER • FIRST FLIGHT: SEPT. 21, 1961**

The first version of the tandem-rotor military helicopter could lift more than seven tons. It had two three-bladed rotors powered by two 2,200-shaft-horsepower (shp) Lycoming T55-L-5 turboshaft engines. By 1965, the growing Chinook fleet had logged more than 50,000 hours, including 14,000 hours of combat service. At peak production during 1967, the Boeing Vertol Philadelphia plant produced a new Chinook every 24 hours. The commercial derivative of the Chinook, the Model 234, first flew Aug. 19, 1980.

BOEING

**CH-46 • SEA KNIGHT • MILITARY HELICOPTER • FIRST FLIGHT: AUGUST 1962**

The medium assault, transport helicopter first was designed for the Marine Corps and Navy. It had a straighter, more-compact fuselage than the Army Chinook and could take off from water or land. By 1968, the Sea Knight had flown 75,000 hours during the Vietnam War. Boeing Vertol delivered more than 600 Sea Knights. A commercial version of the Sea Knight, the Model 107, flew for New York Airways during the early 1960s.

BOEING



**PCH-1 • HIGH POINT • MILITARY HYDROFOIL • FIRST LAUNCH: AUG. 7, 1962**

Boeing hydrofoils adapted aircraft technologies for marine use. Only one PCH-1, the *High Point*, was built and was the basis for later Patrol Hydrofoil Missiles (PHM). While "flying" on its foils, or underwater "wings," the 120-ton boat could reach 57 mph.

BOEING

**Model 727 • COMMERCIAL TRANSPORT • FIRST FLIGHT: FEB. 9, 1963**

The short- to medium-range 727 was the only Boeing-built trijet in its time. It was designed to operate out of small airports with shorter runways. The 131-passenger trijet also was the first Boeing commercial jetliner to use an auxiliary power unit (APU). The 727 also was built as a freighter and as a "quick change" version, which airlines could convert from a passenger transport to a freighter, or a combination of both, as they chose. Between 1962 and 1984, Boeing built 1,832 727s in all versions.

BOEING

**OH-6 • CAYUSE • HELICOPTER • FIRST FLIGHT: FEB. 27, 1963**

The Hughes Model 369 military helicopter and its commercial version, the MD-500, began with the Army's OH-6 Cayuse light observation helicopter. It was the longest-running McDonnell Douglas helicopter program. During the Vietnam War, as many as 100 OH-6s were built a month. Its commercial version was used by law enforcement officials and as an executive transport. The Cayuse also established 23 world records for speed, distance, and altitude.



Hughes Helicopters, Inc.

**XB-70 • VALKYRIE • FIRST FLIGHT: SEPT. 21, 1964**

The North American XB-70 was the largest Mach 3 airplane ever flown. It had a 105-foot wingspan and cruised at 72,000 feet. Powered by six 30,000-pound-thrust General Electric YJ-93 engines, it had a range of 4,288 miles at an altitude of 77,350 feet. The second prototype crashed when its wing was clipped by a chase plane. The first continued to provide supersonic flight test information until it was retired to the Air Force Museum at Wright-Patterson Air Force Base, Ohio.

**DC-9/C-9 • TRANSPORT • FIRST FLIGHT: FEB. 25, 1965**

McDonnell Douglas built 976 DC-9s in eight variations, including 47 aircraft for military customers. Initially designed to hold 90 passengers, the fuselage was lengthened to accommodate more people, and three "stretched" versions took flight. The DC-9-80 was later redesignated the MD-80 and launched a new generation of McDonnell Douglas commercial airliners. The DC-9 military versions included the C-9A Nightingale, the C-9B Skytrain II, and VC-9C VIP government executive transports.

**Gemini • SPACECRAFT • FIRST CREW LAUNCH: MARCH 23, 1965**

The 19-foot-tall McDonnell Gemini spacecraft had nearly twice the interior room of the earlier Mercury capsule and included many technological improvements. NASA selected McDonnell to build the Gemini capsule in 1961, and it was delivered less than two years later. McDonnell also built Agena target vehicle docking adapters and mission and docking simulators. Final splashdown of *Gemini VII* was Nov. 15, 1966.



**OV-10 • BRONCO • FIRST FLIGHT: JULY 16, 1965**

North American developed the Bronco during the Vietnam War as a twin-turboprop, short-takeoff-and-landing (STOL) aircraft. It was the first aircraft especially produced for close support during limited warfare. The Bronco's mission capabilities included observation, forward air control, helicopter escort, armed reconnaissance, gunfire spotting, utility, and limited ground attack. North American delivered a total of 157 OV-10As to the Air Force and 114 to the Marine Corps.

**Lunar Orbiter • SPACECRAFT • FIRST LAUNCH: AUG. 10, 1966**

The Lunar Orbiter was the first U.S. spacecraft to orbit the moon. Boeing built the five 850-pound Orbiters that, without a human aboard, photographed more than 14 million square miles, or about 99 percent, of the moon's surface. They also collected micrometeoroid and radiation environment data and provided information for maps of the lunar gravitational field. *Orbiter 1* photographed an "earthrise" over the lunar horizon and took the first detailed pictures of the far side of the moon.

BOEING

**Model 946-025 • BURNER IVA • BOOSTER • FIRST FLIGHT: SEPT. 15, 1966**

Boeing built 22 Burner IVA boosters between 1965 and 1973. The 68-inch-high boosters were upper-stage vehicles that placed a variety of low- and medium-weight payloads into Earth orbit. Burner II was the first solid-fuel upper-stage vehicle with full control and guidance capability for general space applications. It was originally built for the Douglas-built Thor IRBM and then was adapted for Air Force space boosters.

BOEING

**Model 737-100/-200 • COMMERCIAL TRANSPORT • FIRST FLIGHT: APRIL 9, 1967**

The Boeing 737 twinjet started as a small, short-range jet. The 737-100's use of hardware common to the 707 and 727 lowered maintenance costs. The twinjet was popular in less-developed areas because it could serve remote airfields without much ground support equipment. Nineteen 737s were built as T-43As for the Air Force as navigation trainers. The best-selling 737 airliner evolved into the best-selling 737-300, -400, and -500 during the 1980s and emerged as the new millennium's Next-Generation 737-600, -700, -800, and -900.

BOEING

**PGH-2 • TUCUMCARI • MILITARY HYDROFOIL • FOILBORNE LAUNCH: OCT. 12, 1967**

The 74-foot 7-inch Boeing-built *Tucumcari* was the first hydrofoil in naval history designed as a patrol gunboat. It was extremely maneuverable in water conditions impractical for patrol boats and other vessels its size. The single PGH served during the Vietnam War. It was licensed for construction in Italy as a Sparviero-class missile ship.

BOEING

**Saturn V • LAUNCH VEHICLE • FIRST LAUNCH: NOV. 9, 1967**

The 363-foot-tall Saturn V was the launch vehicle for Project Apollo and Skylab. Boeing built the rocket's massive S-1C first stage, North American the S-II second stage, and McDonnell Douglas the S-IVB third stage. Rocketdyne built the first stage's five F-1 engines and the J-2 engine for the rocket's second and third stages. Twelve Saturn Vs were used on the Apollo moon exploration program, and the 13th, in 1973, placed the McDonnell Douglas Skylab into Earth orbit. Two were placed in storage.

BOEING



ROCKETDYNE



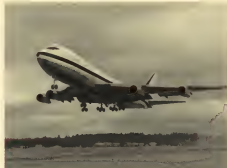


**Apollo** • SPACECRAFT • FIRST CREWED FLIGHT: OCT. 11, 1968

The Apollo program sent nine expeditions to the moon. Six landed 12 astronauts on the lunar surface starting July 20, 1969. North American developed the conical command module, where the crew rode; a cylindrical service module; and the service propulsion system. The last Apollo moon mission was Dec. 7 to 19, 1972. Three Apollo command and service modules were used on the Skylab program, and the last Apollo mission was in July 1975, for the Apollo-Soyuz test project.



North American Rockwell

**Model 747** • COMMERCIAL TRANSPORT • FIRST FLIGHT: FEB. 9, 1969

The gigantic 747 was 231 feet 4 inches long, and its tail was taller than a six-story building. It could hold up to 490 passengers and was also built as a freighter and a convertible. Two 747-100s were modified to carry Space Shuttles. During the 1990s, Boeing delivered two 747-200Bs modified as presidential aircraft to replace the older 707 Air Force Ones. The 747 airframe also was used for the Advanced Airborne Command Post (E-4) for the Air Force. Between 1969 and 1990, Boeing delivered 1,000 747s.

BOEING

**AGM-69** • SHORT-RANGE ATTACK MISSILE • FIRST LAUNCH: JULY 29, 1969

The Boeing-built short-range attack missile (SRAM) first was deployed as a strategic weapon to be carried by FB-111A and B-52 crewed bombers and, later, by the B-1B bomber. Many of the 14-foot missiles could be carried on each aircraft, and their guidance systems provided for individually programmed flights. The last of 15,000 SRAMs rolled out of assembly in 1975.

BOEING

**DC-10** • TRANSPORT • FIRST FLIGHT: AUG. 29, 1970

The Douglas DC-10 could hold from 250 to 380 passengers and was produced in three basic models, the Series 10 for domestic routes to 3,500 miles and the Series 30 and 40 for extended range and intercontinental travel. DC-10s were modified as passenger/cargo convertible versions and as the KC-10 aerial tanker for the Air Force. The last of the giants was delivered in 1990 after a total production run of 446 aircraft.

McDONNELL DOUGLAS

**Lunar Roving Vehicle** • MOON SURFACE EXPLORER • FIRST LAUNCH: JULY 26, 1971

The Boeing-built Lunar Roving Vehicle (LRV) resembled a golf cart and took astronauts over rocky lunar terrain during the latter three Apollo-landing missions. Powered by batteries and rolling on tires made from woven piano wires, the LRVs traveled to the moon folded up and tucked into a small space on the side of the Lunar Module. All three were left parked on the moon.

BOEING

**F-15** • EAGLE • TACTICAL FIGHTER • FIRST FLIGHT: JULY 27, 1972

By 1997, the McDonnell Douglas F-15 Eagle was the U.S. Air Force's premier fighter, and more than 1,200 were in operational service. During Operation Desert Storm, F-15 Eagles accounted for 36 of 41 enemy aircraft shot down in air-to-air combat. By 1998, the improved F-15E Strike Eagle was the world's most technologically advanced fighter, able to fly higher than 50,000 feet at more than Mach 2.5.

McDONNELL DOUGLAS



**Harpoon • ANTISHIP MISSILE • FIRST FLIGHT: DEC. 20, 1972**

The McDonnell Douglas Harpoon antiship missile was originally developed for the Navy but, in 1983, was adapted for use on B-52H bombers. It is an all-weather missile with an over-the-horizon range of more than 67 nautical miles. It can be launched from aircraft, surface ships, submarines, and land-based installations. Twenty-four nations around the world ordered more than 7,000 missiles, including the standoff land attack missile (SLAM), a Harpoon derivative.

McDonnell Douglas

**Model 929-10 • JETFOIL • PASSENGER HYDROFOIL • FIRST LAUNCH: MARCH 29, 1974**

Boeing built 24 JETFOILs between 1974 and 1985. The waterjet-propelled 155-ton boats included a large, windowed cabin for up to 350 passengers and cruised at about 51 mph. They entered service in Hong Kong in 1975. North American Rockwell provided the powerjets for the Boeing JETFOILs.

BOEING

**Mariner 10 • INTERPLANETARY SPACE PROBE • FIRST LAUNCH: NOV. 3, 1973**

During the 1970s, the Boeing-built Mariner space probe skirted Venus and flew by Mercury. Its 170-pound science package included two television cameras, a radio transmitter, and data collection equipment. It revealed cloud circulation patterns on Venus and collected the first high-resolution photographs of Mercury's cratered surface.

BOEING

**Model 928 • PATROL HYDROFOIL MISSILESHP • FIRST LAUNCH: NOV. 9, 1974**

Boeing developed six Patrol Hydrofoil Missileships (PHM) for the Navy. The last, *Hercules*, was commissioned Jan. 15, 1983. They could launch missiles even in rough seas, and they were armed with Harpoon missiles and a single 77-millimeter rapid-fire cannon. Top speed was more than 55 mph.



BOEING

**B-1 • LANCER • BOMBER • FIRST FLIGHT: DEC. 23, 1974**

The North American B-1 was a swing-wing bomber intended for high-speed, low-altitude penetration missions. By the end of 1977, three B-1As had made 118 flights totaling 646 hours of flying time with more than 21 hours at supersonic speeds. Production was canceled June 30, 1977. However, in 1982, the Air Force ordered 100 B-1Bs. The first was delivered June 29, 1985. Currently, the B-1B holds 36 world records in speed, range, and payload capacity. Its operating altitude is 60,000 feet, and it has a range of 7,455 miles.

Rockwell International

**AH-64 • APACHE • ATTACK HELICOPTER • FIRST FLIGHT: SEPT. 30, 1975**

The AH-64 Apache, the world's premier attack helicopter, was designed to be an extremely tough survivor under combat. In 1983, Hughes Helicopter, Inc., later McDonnell Douglas Helicopter Systems, won the prestigious Collier Trophy for the design of the AH-64 Apache. A target acquisition and designation system (TADS), pilot's night vision sensor (PWS), and other advanced technologies add to its effectiveness for ground support. The 1998 version was the AH-64D with Longbow radar and Hellfire missiles.



Hughes Helicopters, Inc.



**E-3 • AWACS • FIRST FLIGHT: MAY 25, 1976**

Boeing used the 707-320 as the aircraft platform for the E-3 Airborne Warning and Control System (AWACS) and the E-3 submarine system. Avionics for AWACS were enclosed in the unique rotodome. In December 1991, Boeing began to use the 767 airframe for the AWACS system. The military also used the 707-320 for the E-6 submarine communication system.

BOEING

**Space Shuttle • ORBITER • FIRST LANDING: AUG. 12, 1977**

The North American Rockwell Space Shuttle had a 78-foot wingspan and was 122 feet long. It could carry five satellites into space and could hold up to seven people. After its successful launch, orbit, and landing in 1981, it was placed on hold until the launch of Space Shuttle *Discovery* on Sept. 29, 1988. There were more than 91 Space Shuttle flights during the remainder of the century.

 Rockwell International
**AV-8B • HARRIER II • V/STOL AIRCRAFT • FIRST FLIGHT: NOV. 9, 1978**

In 1998, the McDonnell Douglas AV-8B was the only fixed-wing vertical short-takeoff-and-landing (V/STOL) aircraft in operational service in the world. It was based on the 1957 British-designed Hawker-Siddeley P.1127. Production of the St. Louis-built AV-8B began in 1981, and the Harrier II entered service with the U.S. Marine Corps in 1983. The United States, Spain, and Italy coordinated efforts to develop the radar-equipped AV-8B Harrier II Plus, which first flew Sept. 22, 1992.


**F/A-18 • HORNET • FIGHTER • FIRST FLIGHT: NOV. 18, 1978**

The McDonnell Douglas F/A-18 Hornet is a multirole fighter that can be used both as a fighter and as an attack aircraft. By 1997, more than 1,200 Hornets were delivered. In November 1986, the Navy's Blue Angels replaced their A-4 Skyhawks with F/A-18 Hornets. In 1991, during the Persian Gulf conflict, while performing an air-to-ground mission, Hornets destroyed two Iraqi MIG-21s in air-to-air combat. The advanced, more powerful F/A-18E/F Super Hornet made its first flight in November 1995.


**AGM-86 • AIR-LAUNCHED CRUISE MISSILE • FIRST FLIGHT: AUGUST 1979**

The Boeing air-launched cruise missile (ALCM), a 3,200-pound self-guided missile armed with a nuclear or conventional warhead, was designed to be deployed from bombers. It could electronically "see" the terrain over which it flew and could travel more than 1,500 miles to its target. By October 1986, Boeing had built 1,715 ALCMs.

BOEING

**Model 767 • COMMERCIAL TRANSPORT • FIRST FLIGHT: SEPT. 26, 1981**

The twin-engine Boeing 767 can carry from 210 to 290 passengers, while its extended-range version can cover distances of more than 7,050 miles. In 1997, Boeing launched a higher-capacity version, called the 767-400ER, that held 304 passengers and had a range of about 6,500 miles. The 767 AWACS first flew Aug. 9, 1996, with the distinctive 30-foot rotodome mounted atop its fuselage. The 767 and the 757 flight decks are identical so pilots can fly either airplane with minimal differences in training.

BOEING



**Model 757 • COMMERCIAL TRANSPORT • FIRST FLIGHT: FEB. 19, 1982**

The twin-engine, medium-range Boeing 757 was up to 20 percent more fuel efficient than the 727s it was designed to replace. The 757-200, also offered as a freighter, can carry 239 passengers in two classes up to 4,520 miles. In September 1996, Boeing launched the 4,000-mile-range 757-300, a stretched model that seats 243 to 279 passengers, depending on configuration.

BOEING

**Roland • MISSILE SYSTEM • FLIGHT TEST: FEBRUARY 1982**

Roland was a mobile, independent fire unit mounted on a vehicle, designed to provide short-range defense against aircraft attacking at low levels. Guided by computer-processed information and radar signals, it could detect targets about 10 miles away. Developed by a French-German consortium, Roland was one of the first foreign-designed weapons systems produced in this country. Boeing delivered the last of 595 Roland missiles in 1985.

BOEING

**Inertial Upper Stage • UPPER-STAGE BOOSTER ROCKET • FIRST LAUNCH: OCT. 30, 1982**

The Boeing-built Inertial Upper Stage (IUS), an unpowered, upper-stage booster rocket, is carried into low Earth orbit by a space shuttle or a rocket, such as the Titan, and then ignited. In April 1988, an IUS sent the *Magellan* spacecraft to the planet Venus. In 1990, an IUS sent *Galileo* to Jupiter and *Ulysses* to the sun. IUS launches continue to place communications and tracking satellites into orbit.

BOEING

**T-45A • GOSHAWK • JET TRAINER • FIRST FLIGHT: APRIL 16, 1988**

The T-45 Goshawk is a carrier-suitable version of the British Aerospace Hawk trainer that first flew in 1974. The U.S. Navy ordered 187 T-45 Goshawks from McDonnell Douglas to replace the TA-4J Skyhawk for advanced jet pilot training and the T-2 Buckeye for intermediate training. The two-seat single-engine Goshawk aircraft trainer is at the heart of the T45TS, the first totally integrated training system package developed for the Navy.

MCDONNELL  
DOUGLAS**Avenger • AIR DEFENSE SYSTEM • FIRST DELIVERY: NOV. 1, 1988**

The Boeing Avenger is a lightweight, highly mobile, and easily transportable surface-to-air missile fire unit that has eight Stinger missiles in two missile pods—one on each side of an all-electric turret—plus a .50-caliber machine gun. Its standalone turret is mounted on a vehicle and, aided by a central computer, a single operator can use it day or night and in adverse weather conditions. Avenger was first deployed during Operation Desert Storm and served during the Persian Gulf conflict.

BOEING

**V-22 • OSPREY • TILTROTOR TRANSPORT • FIRST FLIGHT: MARCH 19, 1989**

Built by Bell Helicopter Textron and Boeing Helicopters, the V-22 Osprey uses medium-lift and vertical-takeoff capabilities to carry troops and cargo. Boeing built the fuselage and all subsystems, digital avionics, and fly-by-wire flight-control systems. Bell was responsible for the wing, transmissions, empennage, rotor, and engine installation. Six Ospreys were produced for testing between 1989 and 1991.

BOEING





**B-2 • BOMBER • FIRST FLIGHT: JULY 17, 1989**

The B-2 bomber, based on the previous Northrop flying-wing experience, is 172 feet wide and 69 feet long. It uses composites and is extremely difficult to track by radar. As part of the industry team led by Northrop, Boeing built the aft and center portions as well as supplied the fuel systems, weapon delivery system, and landing gear. The B-2 can fly more than 6,000 miles without refueling and carries a bombload of more than 40,000 pounds.

BOEING

**F-22 • FIGHTER • FIRST FLIGHT: SEPT. 29, 1990**

Lockheed, Boeing, and General Dynamics teamed to build the F-22 fighter designed to have stealth, supersonic cruise, high maneuverability, advanced avionics, and internal weapons carriage and to be extremely reliable and maneuverable. Initial production began in January 1999.



BOEING

**MD-11 • COMMERCIAL TRANSPORT • FIRST FLIGHT: JAN. 10, 1990**

McDonnell Douglas built the widebody MD-11 trijet as a successor to the DC-10 from which it was derived. It evolved into four versions: a passenger; an all freighter; a convertible freighter; and the "combi," with passengers and freight on the main deck and additional freight below deck. Seating capacity varies from 223 to 410. By January 1998, 174 MD-11s had been delivered.

MCDONNELL DOUGLAS

**C-17 • GLOBEMASTER III • MILITARY TRANSPORT • FIRST FLIGHT: SEPT. 15, 1991**

The McDonnell Douglas C-17 Globemaster III is 173 feet 11 inches long and 55 feet 1 inch tall. It can hold 102 troops, 48 litters, and 54 ambulatory patients and attendants or 170,900 pounds of cargo. It was deployed June 1993. The C-17 has intercontinental range and the heavy-lift capability of the C-5, while needing less airfield length than the C-141. In 1994, the C-17 won the Collier Trophy, cited as the most versatile airlift aircraft in aviation history.



MCDONNELL DOUGLAS

**MH-47E • CHINOOK • SPECIAL MISSION HELICOPTER • FIRST FLIGHT: JUNE 1, 1990**

The Boeing MH-47E established new territory for the Chinook as a surveillance and special-mission aircraft. It has almost twice the fuel capacity of the CH-47D. Its landing gear is further forward to make room for all-composite external fuel pods. It can carry a .50-caliber machine gun and two 7.62-millimeter miniguns.

BOEING

**MD-90 • COMMERCIAL TRANSPORT • FIRST FLIGHT: FEB. 22, 1993**

The MD-90, an advanced midsize, medium-range airliner was first delivered in 1995 and entered service two months later. It holds 155 passengers. Its flight deck includes an electronic flight instrument system (EFIS) and a state-of-the-art inertial reference system.



MCDONNELL DOUGLAS

**International Space Station • CONTRACT: AUGUST 1993**

NASA selected Boeing as the prime contractor for the International Space Station, a permanent orbiting laboratory in space and the largest international scientific and technological endeavor undertaken this century. It took shape in factories and laboratories of 15 nations around the world. The 356-foot-wide space station, slated for completion after the turn of the century, would be in orbit 220 statute miles above the Earth.

BOEING

**Model 777 • COMMERCIAL TRANSPORT • FIRST FLIGHT: JUNE 12, 1994**

The market-driven Boeing 777 twinjet was designed to meet airlines' demands for a jetliner sized between the company's 767-300 and 747-400. The initial 777-200, which was first delivered in May 1995, can hold from 305 to 440 passengers and has a range of 5,680 miles. The longer and heavier 777-300 was first delivered in February 1997 and is capable of flying the same number of passengers up to 8,320 miles. In 1995, the 777 won the Collier Trophy as top aeronautical achievement for the year.

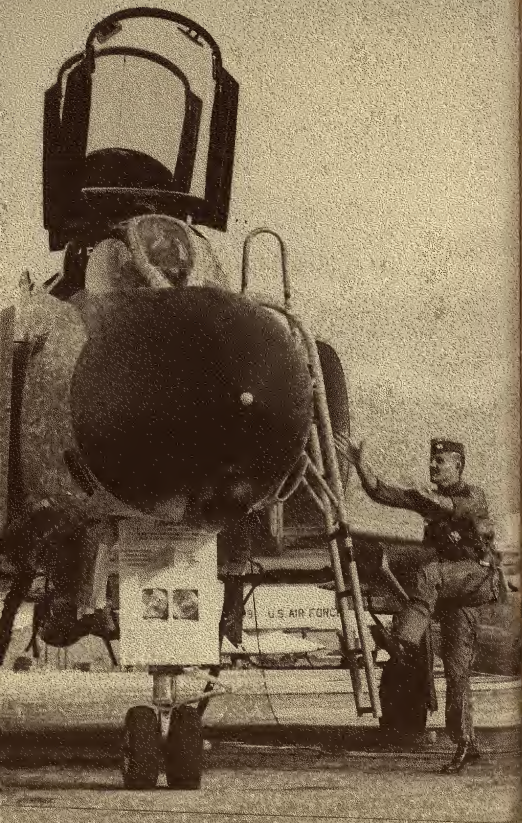
BOEING

**RAH-66 • COMANCHE • FIRST FLIGHT: JANUARY 1996**

Boeing and Sikorsky Aircraft Corporation teamed to develop and build the RAH-66 Comanche armed reconnaissance helicopter. The twin-turbine, two-seat Comanche, scheduled to become operational in 2006, is capable of armed reconnaissance, light attack, and air combat.

BOEING





## *References*

*Aircraft Year Book* (published annually 1927 through 1970).

Avery, Norm. *North American Aircraft 1934-1998*. Volumes 1 and 2. Santa Ana, Calif.: Narkiewicz/Thompson, 1998.

Bauer, Eugene E. *Boeing in Peace and War*. Enumclaw, Wash.: TABA Publishing, 1990.

Bowers, Peter M. *Boeing Aircraft since 1916*. Annapolis: Naval Institute Press (1st edit) 1966, (2d edit) 1968, (3rd edit) 1989.

Franchillon, Rene. *McDonnell Douglas Aircraft Since 1920*, Volumes 1 and 2. London, England: Putnam Aeronautical Books, 1990; Annapolis, Md.: Naval Institute Press, 1988.

Hardy, M.J. *Boeing*. Cambridge, England: Patrick Stephens Ltd, 1982.

Ingells, Douglas J. *The McDonnell Douglas Story*. Fallbrook, Calif.: Aero Publishers, Inc., 1979.

Jane's *All the World's Aircraft*. London: Jane's Information Group Limited, published annually.

Mansfield, Harold. *Vision: The Story of Boeing*. New York: Duell, Sloan and Pearce, 1956, 1966 (also published as *Vision: A Saga of the Sky*. New York: Madison Publishing Associates, 1950, 1984, 1986).

Morrison, W.H. *Donald W. Douglas: A Heart with Wings*. Ames, Iowa: Iowa State University Press, 1991.

Redding, Robert and Bill Yenne. *Boeing: Planemaker to the World*. Greenwich, Conn.: Crescent Books, 1983 (revised edition 1989).

Rodgers, Eugene. *Flying High: The Story of Boeing and the Rise of the Jetliner Industry*. New York: The Atlantic Monthly Press, 1966.

Serling, Robert J. *Legend & Legacy: The Story of Boeing and Its People*. New York: St. Martins Press, 1992.

Yenne, Bill. *Rockwell: The Heritage of North American*. New York, N.Y.: Crescent Books, 1989.

Yenne, Bill. *McDonnell Douglas: A Tale of Two Giants*. London, England: Bison Books, 1985.

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